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FRIEND (R. B.). **The Gypsy Moth in Connecticut.**—*Trans. Conn. Acad. Arts Sci.* **36** pp. 607–629, 32 refs. New Haven, Conn., 1945.

*Lymantria (Porthetria) dispar*, L., has long been the most injurious insect pest of hardwood forest trees in New England, but has caused very little injury in Connecticut, although it has been present there for 40 years and the climate and predominating type of forest are favourable. The author reviews the history of the moth in the United States, describes its bionomics and the injury it causes, and discusses its food-plants and the effect of climate, natural enemies and artificial control measures on it, all largely from the literature. Of the imported natural enemies that have been established against it in the United States [cf. *R.A.E.*, A **33** 238], several occur in Connecticut, where the most important are the predacious Carabid, *Calosoma sycophanta*, L., and the parasites, *Compsilura concinnata*, Mg., *Sturmia scutellata*, R.-D., *Anastatus disparis*, Ruschka, and *Ooencyrtus kuvanae*, How., but they also occur in eastern Massachusetts, where *L. dispar* is much more injurious. Wilt disease and small mammals also afford some control and local outbreaks have been suppressed by artificial measures. Though the reasons for the absence of more frequent outbreaks are not clear, it is concluded that factors of natural control operate in such a way that only sporadic local outbreaks can occur.

Since outbreaks occur only in areas in which favoured food-plants predominate, a survey of the types of forest in Connecticut was begun in 1939, and rough estimates of the moth population indicated by the abundance of egg-masses are being made in favourable areas. The frequency with which an area is surveyed to determine the population trend depends on the number of egg-masses found and the composition of the stand, and control measures are applied when a dangerous population develops and conditions appear to favour a further increase.

YEAGER (J. F.) & HEISHMAN (R. C.). **Some Effects of Antisera on Larvae of the Southern Armyworm, *Prodenia eridania* (Cram.).**—*Ann. ent. Soc. Amer.* **38** no. 1 pp. 45–52, 10 refs. Columbus, Ohio, 1945.

The following is based on the authors' introduction and summary. The possibility was considered of using immune substances, which have great specificity of action, as substitutes for insecticides that are poisonous to man and domestic animals. Specific antibodies for various substances can be produced in the blood of animals if antigens are introduced into their systems. When the antigen is an extract of an animal tissue or organ, the antibody may have a specific action on the kind of tissue or organ extracted, and disease produced in this way may be fatal. The use of specific antibodies for insect control, however, involves a number of serious technical difficulties, the chief of which is to bring about intestinal absorption of an undigested protein. This difficulty is involved in feeding procedure, but can be avoided by the use of an injection technique.

An account is given of tests with antisera against the haemolymph and other tissues of larvae of *Laphygma (Prodenia) eridania*, Cram., prepared by injecting saline extracts of the haemolymph and tissues of sixth-instar larvae into rabbits. Precipitin and agglutinin tests indicated that the titres of the antisera, particularly those against the tissues, were not high, probably owing to certain factors which are discussed. The injection into the larvae of antisera against the haemolymph caused rapid agglutination and a decrease in number of the circulating haemocytes, some degree of passive-active transformation, and probably some precipitation of plasma proteins. The cellular changes were reversible and were most marked up to about six hours after injection. The haemolymph regained its normal appearance within about two days. Rever-

sible haematological changes of a similar nature, but much less marked, were caused when antisera against the gut wall and gut contents were injected into the larvae. No gross changes in the appearance of the other tissues, observed in histological section, followed the injection of the antisera.

Some evidence was obtained that the injection of antiserum specific against the haemolymph may cause the death of some of the larvae; no mortality was obtained in larvae that ingested the antisera or mixtures of them with their food. Haemolymph from either living or heat-fixed sixth-instar larvae can be used in the production of antisera effective against the normal haemolymph of larvae in the fifth or sixth instars.

**Minutes of the 553d regular Meeting of the Entomological Society of Washington March 1, 1945.**—*Proc. ent. Soc. Wash.* 47 no. 6 pp. 182-184, 1 ref. Washington, D.C., 1945.

In the course of this meeting, E. A. Back stated that staves of barrels used for storing and transporting cane-syrup in Georgia were found in December 1943 to be severely damaged by the Bostrychid, *Prostephanus punctatus*, Say, which had burrowed in the wood [cf. *R.A.E.*, A 20 510]. As a result of the damage, considerable quantities of syrup were lost and almost all the barrels in some establishments were rendered unusable. All stages were present in barrels examined in August 1944, and it was concluded that successive generations breed in the damp barrels. Most of the damage seems to be done during the summer, when the barrels are stored empty with both heads in place; it was found in barrels made of oak, gum and cypress wood.

Back also stated that the Eulophid, *Tetrastichus carpatus*, Burks, which was shown in laboratory experiments to be a primary parasite of the larvae of *Tineola biselliella*, Humm. [cf. 32 111], was very abundant in 1944 in warehouses in which wool was stored at three places in Massachusetts and one in New Hampshire. It had not been observed in various stores in the New England States during 1942 and 1943. It was so abundant at one place in Massachusetts that on 29th September the number of adults on a window sill 20 ft. long and 4½ ins. wide was estimated at nearly five million. The parasites were still abundant on the window panes of neighbouring houses on 17th October. It was found that as many as 15 can develop in a single larva of *Tineola*.

**BROMLEY (S. W.). Robber Fly and Japanese Beetle.**—*Bull. Brooklyn ent. Soc.* 40 no. 2 pp. 44-47. Lancaster, Pa., 1945.

The author records nine instances of *Bombomimia grossa*, F., feeding on *Popillia japonica*, Newm., during July and August in 1940-42 at two places in south-western Connecticut where the beetles were abundant. The nine flies concerned comprised five males, two females and two of undetermined sex. Lists based on personal observations and the literature are also given of other insects destroyed by this Asilid in the United States; they include *Hypera punctata*, F., *Macroductylus subspinosus*, F., and *Lymantria dispar*, L. Populations of *P. japonica* increased in south-western Connecticut between 1936 and 1945, and a corresponding increase was observed in *B. grossa*, which was previously scarce. Other Asilids taken by the author feeding on adults of *P. japonica* were *Proctacanthus nigriventris*, Macq., in New Jersey and *P. philadelphicus*, Macq., in New York. The latter has become less numerous in south-western Connecticut since *Popillia* increased in numbers.

HARMAN (S. W.). **Codling Moth Control with Dusts and Sprays.**—*Proc. N.Y. St. hort. Soc.* **90** pp. 46–53. Le Roy, N.Y., 1945.

The codling moth [*Cydia pomonella*, L.] has become of increasing importance in New York during the past 20 years, and this is attributed to concentrated planting of apples, the wide use of a variety that is readily infested and provides a food-supply each year, owing to its annual-bearing habit, and possibly, as in other States [*cf. R.A.E.*, A **32** 350], to the development of strains of the moth resistant to insecticides. Infestation of apples in 1944 was the highest yet recorded in New York, Pennsylvania, Ohio, Virginia and Michigan, but good crops were obtained in western New York where sprays had been carefully applied each year. At the Experiment Station, treatments had previously been necessary only against the first generation, but in 1944, although no sign of damage by the larvae was observed on a block of 60 trees at the end of the first generation (mid-July), 20 per cent. of the apples were infested at harvest.

In comparative orchard tests the infestation figures (numbers of larvae entering 100 apples), were 137 for no treatment, 5 for five cover sprays of lead arsenate (3 lb. per 100 U.S. gals. water), 3 and 5 for five of DDT (0.8 lb. per 100 U.S. gals.), with and without the addition of 1 U.S. quart oil in the last three, respectively, 41 when the second and fifth cover sprays of the DDT schedule without oil were omitted, and 10 when the fifth spray of the schedule with oil was omitted. There was little, if any, visible residue at harvest on fruit sprayed with DDT, and no damage to the trees was observed, except for some browning of the foliage in autumn, which appeared to be unimportant.

In view of the encouraging results obtained with lead arsenate dusts in 1943 [*R.A.E.*, A **33** 149], three dusts were tested in 1944. They had sulphur as the carrier and contained 30 per cent. lead arsenate and 2 per cent. oil or 20 per cent. lead arsenate with 10 or 20 per cent. Black Leaf 155 [14 per cent. fixed nicotine] and 2 per cent. oil. They were applied six times at rates of 2–3 lb. per tree and differed little in effectiveness, the numbers of larvae per 100 apples being 5.5–6.2 for the dusts, 3.1 for five applications of a spray of lead arsenate (3 lb. per 100 U.S. gals.) and 99.7 for no treatment. The dusts were applied under ideal conditions, and the arsenic residues were approximately equal to that left by the spray.

YOUNG (P. F.). **Spraying Problems and new Developments in Control Equipment.**—*Proc. N.Y. St. hort. Soc.* **90** pp. 115–121. Le Roy, N.Y., 1945.

This paper includes notes on the advantages of the Speedsprayer, a machine that was originally designed for spraying *Citrus*, the heavy foliage of which makes spray penetration difficult, but has been used in apple orchards for five years. It has a steel tank with a capacity of 500 U.S. gals., a large petrol engine, and large aeroplane-type propellers that drive a blast of 125,000 cu. ft. of air per minute through a wind tunnel. The air blast is directed towards the tree by means of baffles mounted in the tunnel, and carries a mist of spray released from about 150 small nozzles arranged in four banks on the outer rim of the discharge head. The spray can be cut off from any of the banks by means of control valves and from all by means of a master valve. The equipment is designed to give fast and uniform coverage and to economise in labour and spray materials.

HOUGH (W. S.). **Codling Moth Control Developments in Virginia.**—*Proc. N.Y. St. hort. Soc.* **90** pp. 190–194. Le Roy, N.Y., 1945.

Control of the codling moth [*Cydia pomonella*, L.] on apple in Virginia has become increasingly difficult during the past 25 years, partly because the increased size of the older trees makes it difficult to spray the tops thoroughly

and partly because strains of the moth with larvae resistant to lead arsenate have developed [R.A.E., A 32 350]. Larvae from an orchard, most of which had not been sprayed for five years, were no less resistant than others from orchards that had been sprayed regularly, indicating that once a strain has acquired resistance it does not readily lose it. DDT proved rather more effective than lead arsenate [34 106]; no spray injury was observed on trees that received it, but considerable populations of mites developed on them. Crude soy-bean oil (1 qt. in 100 gals.) is the best adhesive available for use with lead arsenate. Speedsprayers [see previous abstract] have been used to an increasing extent for three seasons. They are of value when nicotine is included in the spray since each tree now can be sprayed on both sides without exposing the operator to the spray. The coverage on young and medium-sized trees depends largely on the speed at which the machine travels. It was not satisfactory on the centre top of tall trees, but very good results were obtained on such trees by applying a supplementary top-off spray from a spray tower on a power sprayer.

STEINER (H. M.). **Experiences with Additives to Lead Arsenate in Codling Moth Control.**—*Proc. N.Y. St. hort. Soc.* 90 pp. 195–207. Le Roy, N.Y., 1945.

Prolonged hot, dry weather in 1943 and 1944 was accompanied by increased damage to apples by the codling moth [*Cydia pomonella*, L.] in Pennsylvania and other eastern States. Lead arsenate, which is effective against it in cool weather, seldom gives satisfactory control at high temperatures on trees with thin foliage, but the crowns of the trees can be kept cooler by preventing injury by sprays and foliage pests and by moderate pruning and heavy applications of fertilisers. In Pennsylvania, lead arsenate cannot be replaced by other insecticides unless they give safe and effective control of the plum curculio [*Conotrachelus nemuphar*, Hbst.] and are also of value against the apple maggot [*Rhagoletis pomonella*, Walsh], but dependence on lead arsenate can be reduced by using it only in alternate sprays or combining it with other insecticides in the same spray, by prompt and thorough application, and by orchard hygiene. In experiments on a commercial scale, satisfactory control was not obtained by the use of substitute insecticides in the second and third of four cover sprays against the first generation, because the change back to lead arsenate for the fourth spray was not accompanied by an adequate deposit of poison. Another disadvantage of changing spray materials in commercial orchards is that the whole surface of each apple is not covered at each application, and protection is therefore less adequate than when the same insecticide is used throughout.

When infestation is heavy the use of supplementary insecticides becomes necessary, and several were tested in 1944 by adding them to the lead arsenate in the second and third of the cover sprays. The use of such materials renders the schedule more flexible, but the number of later sprays depends largely on the degree of control of the first generation and their timing on the portion of it that escapes, and each orchard therefore constitutes an individual problem. The tests were made in orchards at the same altitude on the eastern and western slopes of the same range of hills, and bait-pail catches showed that the flight period of the overwintered generation was more prolonged on the eastern than on the western slopes. Injury by the first generation occurred chiefly at the normal period (4–7 weeks after petal-fall), but was continued to some extent until hatching of the second generation became general. The second generation was larger than usual, and damage was continued until harvest by the development of a partial third generation. The second and third cover sprays contained either 3 lb. calcium arsenate with 1 lb. zinc sulphate and 2 lb. lime (per 100 U.S. gals.) or 3 lb. lead arsenate with the zinc sulphate and lime or

with  $\frac{1}{2}$  U.S. pint nicotine sulphate, 2 lb. Black Leaf 155 [14 per cent. fixed nicotine],  $\frac{1}{2}$  lb. DDT or  $\frac{1}{2}$ , 1,  $1\frac{1}{2}$  or 2 lb. phenothiazine. All these sprays, except that containing DDT, were used on the eastern slope; they were applied on 30th May and 9th June and their effectiveness was compared for the period 30th May–25th July. The sprays containing Black Leaf 155 or  $\frac{1}{2}$  lb. phenothiazine were more effective than that containing nicotine sulphate and more than twice as effective as those containing zinc sulphate and lime, which did not give adequate control. The effectiveness of the phenothiazine increased with its concentration; the spray containing 2 lb. was ten times as effective as those containing zinc sulphate and lime as estimated from injuries on fallen fruits during 22 days of heavy attack. Of the three supplements tested on the western slope, DDT was rather less effective than 2 lb. phenothiazine, but more effective than Black Leaf 155. Populations of the European red mite [*Paratetranychus pilosus*, C. & F.] increased considerably on trees sprayed with DDT and did not do so on those sprayed with phenothiazine; Aphids increased on the terminal shoots of one block of trees sprayed with phenothiazine and then decreased without causing important damage. Slight arsenical injury developed in early September on all trees on which first generation sprays were followed by others of fixed nicotine and oil, but there was no marked difference in the spray injury that could be attributed to the different materials used against the first generation. When three sprays of fixed nicotine with summer oil (3 U.S. quarts per 100 U.S. gals.) were applied against the second generation at intervals of 11 and 12 days, 1 U.S. pint nicotine sulphate fixed with 8 lb. Mississippi X110 bentonite gave better protection than  $1\frac{1}{2}$  lb. Black Leaf 155 mixed with  $\frac{1}{2}$  U.S. pint nicotine sulphate, and caused less scorching of the skin of the fruit; both treatments left visible residues at harvest. Two applications of oil and nicotine sulphate were necessary against the third generation.

Recommendations for the preparation and use of cover sprays containing lead arsenate and phenothiazine, together with the precautions necessary during their use, are given. Pure, micronised, green, unconditioned phenothiazine in which the size of the particles averages 4–5 microns and does not exceed 10 and the lead arsenate should be the only ingredients, and lime should not be applied prior to phenothiazine. A mixture of phenothiazine and lead arsenate might be used against the second generation on apples grown for processing, but is less desirable on those to be sold as fresh, as it affects their colouring and leaves a grey residue.

BRANN JR. (J. L.). **The Use of Dusts for Codling Moth Control.**—*Proc. N.Y. St. hort. Soc.* 90 pp. 210–213. Le Roy, N.Y., 1945.

Work on the control of the codling moth [*Cydia pomonella*, L.] by means of dusts was continued in the Hudson Valley in 1944 on apple trees that were more heavily infested than those used in the previous year [*R.A.E.*, A 33 149]. Five applications at the rate of  $2\frac{1}{2}$ –3 lb. per tree were made against the first generation at approximately weekly intervals from the beginning of June, and three against the second between the end of July and mid-August. The dusts tested, and (in brackets) the percentages of uninjured apples, were: 20 per cent. lead arsenate in micronised sulphur, alone (59.2) and with 2 per cent. dormant oil (69.9); the lead-arsenate dust with the addition of the oil and, in the first three applications against the first generation and the first two against the second, of 10 or 20 per cent. Black Leaf 155 [14 per cent. fixed nicotine] (72.7 and 74.4) or 10 per cent. Black Leaf 155 and 10 per cent. lime (74.6); 20 per cent. phenothiazine in sulphur, with 2 per cent. oil in the first six applications (79.8); and 5 per cent. DDT in pyrophyllite (83.1). The performance of these materials was compared with that of a spray schedule, applied between 31st May and 1st August by the grower, which gave 80.2 per cent. uninjured

apples; it comprised first, second and fourth cover sprays, with a special inside cover applied 4-5 days after the first, each containing 3 lb. lead arsenate and 3 lb. lime [per 100 U.S. gals.], with  $\frac{1}{2}$  U.S. pint nicotine sulphate in the first and second cover sprays and 4 lb. wettable sulphur also in the first, and third and fifth cover sprays each containing  $1\frac{1}{2}$  lb. Black Leaf 155 and  $2\frac{1}{4}$  U.S. qts. 83 per cent. summer oil emulsion. The best control was thus given by DDT, though it was tested on only four trees; it left no residue on the fruit and caused no injury to the trees. Phenothiazine left little or no residue on the fruit at harvest, but is too costly for general use on a commercial scale.

On the basis of these results, dusts are recommended for use against *C. pomonella* only in districts where infestation is not heavy, since the deposits left are too light and the period of protection too short for successful control where populations are increasing. They might be of value as a temporary measure in orchards in which it is not possible to spray all the trees within the recommended period of three days.

**BAKER (H.). The Relation between Bait-trap Catches and Codling Moth Emergence and Egg Laying.**—*Bienn. Rep. Kans. hort. Soc.* 46 pp. 31-35. Topeka, Kans., 1942.

The following is largely based on the author's summary. In view of evidence that the activity of adults of the codling moth [*Cydia pomonella*, L.] is not always accurately indicated by bait-trap catches, the relation between such catches and emergence and oviposition was investigated in apple orchards in the Missouri River Valley (Kansas) in 1939 and 1940. Records of emergence obtained by examination of trees for empty pupal skins indicated when and in approximately what numbers eggs were deposited in both years, except during a period when rainfall interfered with the activity of the moths. Catches in traps baited with a 10 per cent. solution of brown sugar with the addition of 0.5 cc. natural oil of sassafras per U.S. quart indicated when moths were present, but although the size of the catches fluctuated in response to fluctuations in the number of moths emerging, they were not proportionate to the number of moths that emerged. Traps caught many more moths in proportion to the number that emerged during the spring than at any other time during either season. They indicated the beginning and peak of oviposition by moths of the overwintered, first and second generations with sufficient accuracy for practical purposes, but did not indicate the rate at which oviposition declined after periods of peak activity or the number of eggs deposited. The data indicate either that the particular bait used was more attractive to newly-emerged moths than to older ones or that the newly-emerged moths are the more responsive to baits. Since moths were caught in bait-traps and eggs were found when or soon after there was any evidence that moths were present, the bait-traps afford a practical basis for timing spray applications in the Missouri River Valley. As, however, it appears that oviposition declines less rapidly than the bait-trap catches after periods of peak activity, care should be taken to maintain an adequate spray cover on the trees for some time after there has been a marked decline in the catches.

**PARKER (R. L.) & LAMERSON (P. G.). Lead Arsenate Soybean Flour and Lead Arsenate Zinc Sulphate Combination Sprays for Codling Moth Control during the Season of 1940.**—*Bienn. Rep. Kans. hort. Soc.* 46 pp. 81-90. Topeka, Kans., 1942.

Sprays tested for the control of the codling moth [*Cydia pomonella*, L.] on apple in north-eastern Kansas in 1940 all included lead arsenate, since other materials had proved unsatisfactory in previous years [cf. R.A.E., A 27 166;

28 477]. The first and second generations were both large, but only the first caused heavy damage, and it was doubtful whether or not a partial third developed. The season was one in which lead arsenate injured the leaves of Jonathan apples wherever an adequate safener was not used with it; weak Bordeaux mixture (12 oz. copper sulphate and 24 oz. lime per 100 U.S. gals.) appeared adequate, and zinc sulphate (4 oz. per 100 U.S. gals.) was almost as effective. The schedule tested comprised a calyx and nine cover sprays containing 4 lb. lead arsenate per 100 U.S. gals. The first cover spray was on 23rd May and the last on 7th September. Adhesives and spreaders were not used until the third cover spray (13th June), and summer oil emulsion was not included in sprays subsequent to the fifth cover (12th July). The percentages of uninjured apples (including both harvested and dropped fruit) were 83 for lead arsenate used alone, 85.8 for lead arsenate and summer-oil emulsion (1 qt. per 100 gals.), and 78.3 for lead arsenate and summer oil when zinc sulphate (4 oz. per 100 U.S. gals.) was added to the sprays, but all treatments not including zinc sulphate caused heavy loss of foliage. The effective control given by lead arsenate used alone or with oil is attributed to the even distribution of rainfall throughout the season. The percentages of uninjured apples following applications of lead arsenate with 4, 2 or 1 oz. Spraysoy A or 4 oz. crude soy-bean flour were 79.9, 72.9, 69.5 and 73.6, respectively. The arsenical residue left after the fruit had been washed in a commercial washing machine in all cases exceeded the legal tolerance (0.025 grains arsenic per lb. in 1940); this is attributed in part to the heavy dosage, the lateness of the last application and the severe foliage injury, which prevented the fruit from increasing in size, and in part to the fact that the acid wash employed contained only 1 per cent. acid, instead of the recommended 3 per cent., and was not heated.

PARKER (R. L.) & LAMERSON (P. G.). **Control of the American Strawberry Leafroller during the Season of 1940.**—*Bienn. Rep. Kans. hort. Soc.* 46 pp. 91-98. Topeka, Kans., 1942.

Damage to strawberry by *Ancylis comptana*, Froel. (*fragariae*, Walsh & Ril.) was less evident in Kansas in 1940 when weather conditions were favourable for the growth of the plants, than during the previous five years, which were characterised by drought. Adults of the overwintered generation were first observed on 18th April and oviposition reached a peak from 7th to 15th May. Larvae of the first, second and third generations were first observed on 11th May, 3rd July and 17th August, respectively; there was no partial fourth generation.

In experiments against the first generation, sprays applied three times, on 16th, 22nd and 27th May, while the larvae were present, were compared with an application of 1½ lb. lead arsenate and 1 U.S. pint oil (Orthol K Ready Mix) in 50 U.S. gals. water on 8th May followed by one of ½ U.S. pint nicotine sulphate, 5 U.S. pints coconut-oil soap and ½ lb. lime in 50 U.S. gals. on 10th May. This treatment gave 79 per cent. control (as compared with untreated plots), but it was found that the mixture of nicotine sulphate, soap and lime was not compatible and formed a precipitate. Of the sprays that were applied three times, ½ U.S. pint nicotine sulphate and 1 U.S. pint oil (in 50 U.S. gals.) gave 97 per cent. control, the same with the addition of ¾ lb. Wyoming bentonite and ¼ oz. Dreft 90 per cent., ½ U.S. pint nicotine sulphate and 5 U.S. pints coconut-oil soap 88 per cent., and 2 lb. Black Leaf 155 [14 per cent. fixed nicotine] and 1 U.S. quart oil 79 per cent. Sprays containing Lethane [thiocyanate] preparations were less effective and scorched the leaves; some gave no control. The sprays of nicotine sulphate and soap injured the foliage, so that it later appeared dwarfed, and bentonite left an undesirable deposit on the fruits. Sprays were also applied three times, on 27th June and 8th and

18th July, and on 10th, 20th and 28th August, against the second and third generations. The percentages of control obtained were 79 and 76, respectively, for 1½ lb. lead arsenate and 1 U.S. pint oil (per 50 U.S. gals.), 91 and 90 when ½ U.S. pint nicotine sulphate was added to this, and 89 and 91 for 2 lb. Kalo [natural cryolite] and 1 U.S. pint oil.

Dusts containing 5 and 10 per cent. Pyroclide (0.1 and 0.2 per cent. pyrethrins, respectively) were applied against the larvae of all generations, on the same dates as the sprays that were applied three times, and gave 59 and 81.5 per cent. control, respectively, of the first, 66 and 75 per cent. of the second, and 71 and 70 per cent. of the third.

DEAN (G. A.). **Control of Three Red Cedar Scales.**—*Bienn. Rep. Kans. hort. Soc.* 47 pp. 80–82, 1 ref. Topeka, Kans., 1944.

Of the three Coccids here recorded on red cedars [*Juniperus*] in Kansas, *Cryptaspidiotus shastae*, Coleman, was a serious pest in many central and north-eastern districts during 1934–39, but is well controlled by summer applications of a spray of nicotine sulphate and oil [R.A.E., A 29 632]. *Pseudococcus juniperi*, Ehrh., has recently been injurious at several places, but might be controlled by the same spray if it was applied while the eggs were hatching. The third species was tentatively determined as *Eulecanium* (*Lecanium*) *fletcheri*, Ckll., by H. Morrison, who states that it is closely related to *E. (L.) corni*, Bch., and has also been reported from arbor-vitae [*Thuja*] in the United States, but that little is known of its bionomics, which probably resemble those of *E. corni*, or of its control, since it has not caused serious injury. It might be controlled by a dormant oil spray applied before growth begins, followed, if necessary, by two applications of the spray recommended against the other Coccids, the first in late May or early June and the second about nine days later.

PARKER (R. L.) & LAMERSON (P. G.). **Preliminary Report on the Biology and Control of the Strawberry Rootworms, *Paria canella* (Fab.) and *Graphops pubescens* Mels.**—*Bienn. Rep. Kans. hort. Soc.* 47 pp. 114–116. Topeka, Kans., 1944.

Strawberries in Kansas are attacked by the adults of *Paria canella*, F., and *Graphops pubescens*, Melsh., which feed on the foliage in early summer and mid-summer, respectively, and by the larvae of these Eumolpids, which feed on the roots. *P. canella* overwinters in the adult stage in the leafy débris at the base of the plants. In laboratory studies in 1943, eggs were deposited between 4th May and 16th June in masses on dead strawberry leaves and, to a less extent, on living leaves, under the scales surrounding the base of the plants and on the soil beneath the leaf débris. The egg stage lasted 9–25 days, and most of the new adults emerged between 25th July and 26th August. In the field, the overwintered beetles appear during April and feed for about a month before ovipositing; larvae were first observed on 24th June and pupae on 13th July, and emergence of the adults continued from about 26th July until September.

The value of poisoned apple-pomace baits in controlling the adults of *P. canella* during the early feeding period was tested in experimental plots in 1943. Two applications were made, on 23rd April and 12th May, and the numbers of injured and uninjured leaves per plot were counted on 7th–11th June. The baits tested contained 15 lb. apple pomace, and the materials added to this and (in brackets) the percentages of undamaged leaves were ¾ lb. sodium fluosilicate, alone (65.5), with 1 lb. sugar (80.6) or with 1 lb. sugar and 10 lb. soy-bean meal (72.5), ¾ lb. lead arsenate, alone (77.8) or with 1 lb. sugar (79.1), and ¾ lb. cryolite, alone (70.7), with 1 lb. sugar (72.6) or with 1 lb.

sugar and 10 lb. soy-bean meal (71.2). A proprietary apple-pomace bait gave 79 per cent. undamaged leaves, and no treatment 45 per cent. In experiments in which soil fumigants were applied to plants in the row, carbon-bisulphide emulsion at the rates used killed the plants as well as the larvae and pupae, and  $\beta$ - $\beta$ 'dichlorethyl ether at concentrations of 24 or 32 cc. per U.S. gal. and a rate of 1 U.S. quart per sq. ft. caused light foliage injury and killed only 50 and 33.3 per cent. of the larvae, respectively.

*G. pubescens* overwintered in the larval stage. In 1943, the overwintered larvae pupated from 4th May; emergence of the adults began on 3rd June, and oviposition on 3rd July. The eggs were deposited singly on dead leaves.

NEISWANDER (R. B.). **Biological Aspects of the Plum Curculio Problem on Peach.**—*Proc. Ohio hort. Soc.* **77** pp. 22-28, 4 graphs. Columbus, Ohio, 1944.

Counts of the adults of the plum curculio [*Conotrachelus nenuphar*, Hbst.] jarred from peach trees in orchards in Ohio at weekly intervals in 1940, 1942 and 1943 showed that they were relatively scarce at petal-fall, which occurred between 6th and 25th May in the different localities and years, but appeared in considerable numbers within the next few days. They were most numerous 15 days after petal-fall in 1940 and 1942 and seven days after it in 1943. Their numbers decreased after sepal-fall in 1943, the only year in which the counts were continued until harvest, and increased again during July, when the new generation emerged. Damage to peaches ceases when the pits begin to harden, and if eggs are deposited at this period, few of the larvae survive. The fruit again becomes susceptible when it swells prior to ripening, but the overwintered adults have by that time almost ceased to oviposit, and only the earliest ripening varieties provide suitable food for late larvae. No evidence of oviposition by adults in the year in which they emerge has ever been obtained in Ohio. The weevils were most numerous on trees near woodland in 1940, a neglected apple orchard in 1942 [*cf. R.A.E., A* **32** 174] and a wide fence row in 1943.

In 1942 and 1943, fallen infested fruits were collected in June, and the larvae that emerged from them were placed in cages set in the ground, in which they completed their development. They emerged from the fruits from 4th June until 10th July in 1942 and from 12th June until 20th July in 1943, and the adults emerged from the soil from 10th July until about 3rd August in 1942 and until about 15th August in 1943. Many pupae can be destroyed by weekly cultivation of the soil during July [*loc. cit.*], and as the larvae do not migrate on leaving the fallen fruit, special attention should be paid to the area beneath the branches.

In experiments with sprays in 1943, a single application at sepal-fall of a spray containing 3 lb. acid lead arsenate per 100 U.S. gals. with zinc sulphate and hydrated lime resulted in fewer larvae per 100 fallen fruits than one of 4 lb. basic lead arsenate with hydrated lime or of 4 lb. Dutox [72 per cent. barium fluosilicate and 8 per cent. sodium fluoaluminate per 100 U.S. gals.]. Two applications of acid lead arsenate (2 lb. per 100 U.S. gals.) with zinc sulphate and lime reduced the numbers of larvae in fallen fruits by 71 per cent. when made at sepal-fall and again two weeks later, but were less effective at petal-fall and sepal-fall, though more so than a single application at sepal-fall. Since acid lead arsenate injures the trees in certain seasons and basic lead arsenate requires three applications at weekly intervals for effective control, it is suggested that spraying should be replaced by cultural measures, especially when the set of fruit is heavy. These comprise the avoidance of sites adjacent to woodlands and of mulch or cover crops that provide shelter during August and September, the removal of shrubs and dense plant growth from fence rows and adjacent fields, and frequent cultivation of the soil during July.

NEISWANDER (R. B.). **The Peach Tree Borer.**—*Proc. Ohio hort. Soc.* **77** pp. 29–32. Columbus, Ohio, 1944.

The author gives notes on the bionomics of the peach tree borer [*Aegeria exitiosa*, Say] and describes experiments in a heavily-infested orchard in Ohio in 1942 to compare the value of paradichlorbenzene, Parascalcide [a commercial preparation of paradichlorbenzene dissolved in a miscible oil] and ethylene-dichloride emulsion, all of which had previously given promising control in small-scale tests [cf. *R.A.E.*, A **32** 174]. The treatments were delayed until 7th October, in order to investigate their effectiveness under cool conditions, and the trees were mounded to a depth of 5 ins! immediately after them and examined in the spring of 1943. The numbers of larvae then found per 100 trees were 0 for a 20 per cent. emulsion of ethylene dichloride applied at the rate of  $\frac{1}{2}$  U.S. pint per tree, 20 for Parascalcide diluted 1 to 7 at  $1\frac{1}{2}$  U.S. pints per tree, 59 for paradichlorbenzene at 1 oz. per tree and 432 for no treatment. Ethylene dichloride was thus the most effective, but it should not be applied in warm weather, and it has been known to kill vigorous trees in Ohio at the dosage used. Paradichlorbenzene would probably have been more effective had it been applied in warmer weather, and it is considered that it should be applied not later than the second half of September in northern Ohio, though it can probably be used as late as mid-October in the southern part of the State. If treatment is required later in the autumn or in spring, Parascalcide is likely to give better results; it has been used extensively on nursery trees without causing injury.

CUTRIGHT (C. R.) & VOGEL (M. A.). **Codling Moth Experiments in 1942 and 1943.**—*Proc. Ohio hort. Soc.* **77** pp. 73–74, 76–78, 80–82, 84–86, 88–90, 92, 1 fig. Columbus, Ohio, 1944.

High temperatures in April, May and June were favourable for the codling moth [*Cydia pomonella*, L.] on apple in Ohio in 1942, and damage was severe in many orchards. In 1943, pupation was retarded by cold in April, and adult emergence by temperatures slightly below normal in May, but hot weather in June accelerated development so that the first larvae left the fruit slightly earlier than the average date and severe damage was again common. The general effects of hot weather on the development of infestation are summarised.

The spray schedule adopted in 1942 and tested in two localities comprised an application at petal-fall followed by seven cover sprays, and the experimental programme began with the second cover spray. The sprays were applied at rates of 30–40 U.S. gals. per tree from the ground and from a tower, and the results are shown in tables. All quantities given for spray ingredients are per 100 U.S. gals. water. Two schedules in which lead arsenate was used at 2 lb. were inferior to two at the standard concentration of 3 lb., and did not give adequate protection. Lead arsenate at 3 lb. was more effective in reducing both infestation and superficial injuries when combined with 3 lb. lime, 1 lb. zinc sulphate and (in three cover sprays against the first generation)  $\frac{3}{4}$  U.S. gal. summer oil than with flotation sulphur, lime, zinc sulphate and an adhesive, and the effectiveness of the first combination in controlling infestation was reduced when the oil was omitted. A schedule of 3 lb. lead arsenate and flotation sulphur in which  $1\frac{1}{2}$  lb. Black Leaf 155 (14 per cent. fixed nicotine) was included in three cover sprays appeared to be less effective than 3 lb. lead arsenate with oil, but the difference was not statistically significant. A schedule of sprays containing only  $1\frac{1}{2}$  lb. Black Leaf 155 and  $\frac{1}{2}$  U.S. gal. summer oil caused the greatest reduction in superficial injuries, but did not give satisfactory control of actual infestation; when the concentration of Black Leaf 155 was increased to 2 lb., however, excellent control was obtained and the condition of both fruit and foliage was outstanding. The addition of summer

oil to standard lead arsenate in three cover sprays against the first generation was more effective in reducing infestation and superficial injuries than an increase in the concentration of lead arsenate to  $4\frac{1}{2}$  lb. in three cover sprays, and the use of lead arsenate at concentrations higher than 3 lb. is therefore not recommended except in special cases.

In 1943, the same number of sprays was applied, but experimental applications began with the petal-fall spray in tests in which Fermate [ferric dimethyldithiocarbamate] was included as a fungicide. In one district, a spray of Black Leaf 155 and summer oil was very effective in reducing superficial injuries and also gave good control of infestation, but when Fermate was added, both infestation and superficial damage increased, though the latter was still lower than following lead-arsenate schedules. When Fermate is used with oil, a blotchy residue is left on the fruit, and the effect of three proprietary spreaders in preventing this was tested; sprays containing two of them both gave good control of superficial damage and fairly good control of infestation, and the appearance of the fruit was good. A schedule in which lead arsenate at 3 lb. was reinforced with  $1\frac{1}{2}$  lb. Black Leaf 155 and an adhesive in five cover sprays gave greater reductions in infestation and superficial injuries than one in which the nicotine and adhesive were included in only three cover sprays against the first generation; a spray of lead arsenate, oil, lime and zinc sulphate reinforced with Black Leaf 155 in three cover sprays against the first generation was as effective in controlling infestation but permitted more superficial damage. The inclusion of DN-111 [a preparation containing about 20 per cent. of a dicyclohexylamine salt of dinitro-orthocyclohexylphenol] at 1 lb. in two cover sprays or at 1 lb. or 10 oz. throughout the season did not improve the control given by lead arsenate, but was very effective against the red mite [*Paratetranychus pilosus*, C. & F.] and the condition of foliage treated with it was good. Similar results were obtained in general in the other district in which tests were made; the standard lead-arsenate spray containing zinc sulphate and lime, reinforced with oil in three first-generation cover sprays, gave the best control of infestation, though the percentage of superficial injuries was high.

By summarising the results of several schedules utilising the same materials or combinations of materials, it was found that the protection given by lead arsenate was about the same whether or not it was reinforced with oil or Black Leaf 155 against the first generation. The percentage of superficially damaged apples in the plots sprayed with Black Leaf 155 and oil was little more than half that on plots that received lead arsenate alone, the percentage infestation was about the same, and the use of these materials does not involve washing the fruits at harvest.

Good commercial control was obtained in 1943 by growers who used a lead-arsenate schedule in which the first cover spray, which contained sulphur to control scab, was followed by a spray containing a heavy concentration of Black Leaf 155 and by third and fourth cover sprays containing oil. Four schedules for use in heavily-infested orchards in which scab is controlled early or late and the apples are or are not to be washed are given in a table.

**Pest Control.**—65th Rep. N.J. agric. Exp. Sta. 1943-44 pp. 27-30. New Brunswick, N.J. [1945.]

Work on insect pests and their control in New Jersey during 1943-44 is summarised. Damage to wheat and barley by *Protoleucania albilinea*, Hb., in the spring of 1944 was the most widespread yet recorded in the State and caused losses of 50-80 per cent. of the crop in infested fields in the south. In tests of sprays against the codling moth [*Cydia pomonella*, L.] on early-maturing varieties of apple, DDT at a concentration of 1 lb. per 100 U.S. gals. was 10-15 times as effective as the standard lead-arsenate schedule. It was found that many growers do not obtain even coverage when spraying apple trees; in

some cases 70 per cent. more spray was applied to the lower branches than to the top, in which infestation by pests and diseases was consequently severe. Even distribution appeared to depend more on the efficiency of the operator than on the method of application. In the course of an investigation on arsenical injury caused to fruit trees by spray, the order in which the lead arsenate and other spray ingredients were added to the water was varied, and the amount of water-soluble arsenic in the mixtures was determined a short time afterwards. The results indicated that the order of mixing was of less importance than the individual constituents. Lime-sulphur increased the amount of water-soluble arsenic and lime reduced it, as did the sulphates of manganese or zinc, provided that lime was also present. When Bordeaux mixture is mixed in the spray tank, the copper sulphate and lime should be added before the other ingredients. In work on the control of the oriental fruit moth [*C. molesta*, Busck] by the liberation of *Macrocentrus ancylovorus*, Rohw., indications were obtained that releasing relatively small numbers of the parasite against the first generation may be as effective as releasing larger numbers against the second and third.

Newly-transplanted tomato plants are seriously damaged, especially in southern New Jersey, by insects that attack the foliage, including the Colorado potato beetle [*Leptinotarsa decemlineata*, Say] and the potato flea-beetle [*Epitrix cucumeris*, Harr.]. Experiments in five different parts of the State in two years indicated that dipping the plants in a spray material prior to planting protects them both from insect attack and from too rapid loss of moisture. The most promising mixture so far tested is one containing  $\frac{1}{2}$  lb. acid lead arsenate in 15 U.S. gals. water with the addition of summer oil emulsion to provide 0.25-1 per cent. actual oil.

**SALT (R. W.). Number of Generations of *Lygus hesperus* Knt. and *L. elisus* van D. in Alberta.**—*Sci. Agric.* 25 no. 10 pp. 573-576, 1 graph, 4 refs. Ottawa, 1945.

Owing to the difficulty of rearing *Lygus hesperus*, Knight, and *L. elisus*, Van D., in captivity, most published data on the number of generations that they produce in a year are based on composite records from the rearing of the various stages. From these the life-cycle has been reported as requiring from 20 to 46 days, and by dividing these periods into the length of the active season, it has been concluded that there were 3-7 generations in the year [cf. R.A.E., A 16 31; 27 463]. The author points out that this method takes no account of the fact that the time required for different individuals to complete a generation varies with complex ecological and nutritional factors, and that any attempt to strike an average for calculating the number of generations a year only increases the error. He therefore made observations on the number of generations of these Capsids by sweeping in the summer of 1938 in a lucerne seed field in Alberta, which remained uncut during the whole period; samples were taken approximately once a week until the first appearance of nymphs and twice a week afterwards. No attempt was made to distinguish the two species, which are so intermingled in many areas and have such similar habits that for most practical purposes they may be treated as one. The population curves for each nymphal instar and for adults are shown on a graph covering the periods from late April to mid-October, and study of each of these as a separate entity indicated that there were only two generations in this period.

Similar treatment of the results obtained in 1931 by Shull in southern Idaho [22 214] indicates that there were only two generations between 27th April and 18th August in that area, and not four as he concluded by combining the population figures of various stages, though another one might have developed later.

MCKENZIE (H. L.). **A Revision of *Parlatoria* and closely allied Genera (Homoptera : Coccoidea : Diaspididae).**—*Microentomology* 10 pt. 2 pp. 47–121, 1 map, 33 figs. Stanford Univ., Calif., 1945.

The author gives a bibliography and historical review of the genus *Parlatoria*, defines its characters and gives a list of 83 names of species (including misspelt names) that have at any time been referred to it and another of the 38 species, including two new ones, that he considers so referable and of their synonyms. The food-plants, distribution and characters of the 38 species are given, and their type localities are shown on a map. *P. phyllanthi*, Green, is considered a distinct species and not a variety of *P. pergandei*, Comst. [cf. *R.A.E.*, A 4 13]. A key to the species is included and, except for a few isolated forms, they are arranged in five taxonomic groups.

The allied genera dealt with are *Genaparlatoria*, *Parlatoreopsis*, *Syngenaspis*, *Parlagentia*, gen. n., and *Parlaspis*, gen. n. The only species of *Genaparlatoria* is *G. pseudaspidiotus*, Lind., of which *Parlatoria mangiferae*, Marl., is a synonym. *Parlatoreopsis* comprises *Parlatoria pyri*, Marl., and *P. chinensis*, Marl., of which its type, *Chionaspis longispina*, Newst., is a synonym. The only species of *Syngenaspis* is *S. parlatoriae*, Šulc (sulci, Bodenh.). *Parlagentia* is erected for *P. inops*, sp. n., from China, and *Parlaspis* for *Parlatoria papillosa*, Green [8 205], these being their only species. The food-plants, distribution and characters of the species in these genera are given.

A key to all the six genera dealt with is appended, and their geographical range is discussed.

DURAN M. (L.) & OLALQUIAGA FAURÉ (G.). **Plantas huéspedes del bruco común del frejol determinadas en el valle de Limache.** [Food-plants of the Bean Bruchid found in the Limache Valley.]—*Agricultura téc.* 4 (1944) no. 2 pp. 230–244, 3 figs., 14 refs. Santiago, Chile [1945]. (With a Summary in English.)

The campaign for the eradication of *Bruchus (Acanthoscelides) obtectus*, Say, on beans (*Phaseolus*) in the Limache Valley [cf. *R.A.E.*, A 32 100] did not prove successful, and the Bruchid was still present there at the end of 1944. Investigations on possible alternative food-plants were therefore carried out. Samples of seeds injured by Bruchids were collected in the course of the eradication campaign and *B. obtectus* was found in those of *Dolichos lablab*, broad bean (*Vicia faba*), chick pea (*Cicer arietinum*) and *Vigna unguiculata (sinensis)* in addition to several species and varieties of *Phaseolus*. Seeds of 25 other plants related to these or similar in morphology, as well as those of *P. vulgaris*, were exposed to attack in the laboratory by a technique that is described in detail. Eggs of *B. obtectus*, deposited on seeds of *P. vulgaris* by adults of approximately equal age, were collected and scattered over the seeds to be tested, which were kept in the dark at 30°C. [86°F.] and 75–89 per cent. relative humidity. Under these conditions, the larvae hatched in 48 hours and either entered the seeds within 12 days or died. They entered the seeds of favoured food-plants much sooner than others. The seeds were examined finally at the end of five months, and the numbers of seeds used, the numbers showing deep and superficial injury, the numbers of deep and superficial punctures, and the numbers of larvae that gave rise to adults are shown in a table. All the 249 seeds of *P. vulgaris* were punctured, and 1,053 adults developed; 6, 39 and 30 developed in pea, sweet pea (*Lathyrus odoratus*) and lentil, the numbers of seeds concerned being 490, 414 and 1,779, respectively. The seeds of 16 species showed some proportion of deep punctures, but did not permit the development of adults, and those of the other six showed only superficial feeding, with no successful establishment of larvae.

DURÁN M. (L.). **Un enemigo natural de la *Saissetia oleae* (Bern.) nuevo para Chile.** [A natural Enemy of *S. oleae* new to Chile.]—*Agricultura téc.* 4 (1944) no. 2 pp. 255–256. Santiago, Chile [1945].

Inspection in January 1944 of groves of olive and orange in the Azape valley, which had been heavily infested with *Saissetia oleae*, Bern., ten years before, showed them to be in excellent condition, and *Metaphycus lounsburyi*, How., was bred from a few adult female scales showing 3–5 punctures, collected in an olive grove. This Encyrtid was not known to occur in Chile; it had formerly been introduced into Santiago [cf. *R.A.E.*, A 31 290] but did not become established and had never been introduced into the Azape or neighbouring valleys. It probably migrated into the Azape valley from Peru, possibly from Tacna, in 1943 or a little earlier.

The establishment of this parasite in Chile is important, since it is known to give effective control of the scale and is adapted to conditions in the coastal regions, where the host is present in all stages throughout the year and it can overwinter in gravid females. It is probably unable to survive the winter in the neighbourhood of Santiago, but it may be possible to use it there in the other seasons. It is being introduced in the central zone and has already been recovered in large numbers.

The possibility of introducing *M. helvolus*, Comp., which is more effective than *M. lounsburyi* against *S. oleae* in some parts of California, is considered.

MARSHALL (Sir G. A. K.). **New Cureulionidae (Col.) from Tropical Africa.**—*Ann. Mag. nat. Hist.* (11) 12 no. 91 pp. 429–448, 1 fig. London, 1946.

The new species described include *Omotrachelus bigranulatus*, attacking nursery *Cinchona* trees in southern Nigeria, *Rhamphus senegalensis*, feeding on flowers of salads and cowpeas [*Vigna unguiculata*] and *Lobotrachelus bidentipes* on flowers of mango, both in Senegal, and *Baris cucurbitae* and *Phloeophagosoma cucurbitae* on cucurbits in Kenya and Senegal, respectively.

SMEE (C.). **Notes on Plant Virus Diseases with particular Reference to Tobacco.**—*Nyasaland agric. quart. J.* 5 no. 4 pp. 73–89. Blantyre, 1945.

The author gives a short popular account of virus diseases of plants, with a list of those to which crops grown in Nyasaland are susceptible. Tobacco viruses found in Nyasaland are dealt with in some detail. Those that have insect vectors are crinkle or leaf-curl [*Ruga tabaci* of Holmes] and rosette. Crinkle is transmitted by a whitefly [? *Bemisia*] that has many food-plants, though only two of these, tomato and *Vernonia*, are thought to harbour the virus in Nyasaland, and rosette by an Aphid that had previously been identified as *Myzus persicae*, Sulz., but is now considered to be at least a distinct race of this species. Unlike the latter, its food-plants appear to be very limited, and it may not be important in the transmission of plant viruses in general. No oviposition by it has been observed. Between tobacco crops, the apterae live during the dry season mainly on *Gynandropsis pentaphylla*, giving rise to winged forms when the tobacco is planted. The Aphid has not been found on *Cleome monophylla* until the middle of January, when it is sometimes abundant, and it seems unlikely, therefore, that it survives the dry season on this weed; tobacco plants left in the ground do not seem to be important to its survival [cf. *R.A.E.*, A 33 85; 34 62, etc.]. It is not known whether the kromnek virus [*Lethum australiense* var. *typicum* of Holmes], which is carried by thrips, occurs in Nyasaland.

Notes are given on the bionomics and control of the insect vectors, but the most important means of safeguarding tobacco from the viruses is by eliminating plants that harbour them from the neighbourhood of tobacco seed-beds and fields.

SMEE (C.). **A Caterpillar eating air-cured Tobacco.**—*Nyasaland agric. quart. J.* 5 no. 4 pp. 94-95. Blantyre, 1945.

Unidentified caterpillars fed on tobacco leaves in curing sheds in the Balaka area of Nyasaland in April 1944 and in the Lilongwe district in April 1945. Larvae from the two areas were similar, and those in the Lilongwe district were seen to come from the grass thatching of the sheds. The grass had been cut early in February and March, and the larvae were noticed when the leaf part of the grass had been demolished. The roofs of some of the sheds were completely destroyed, and the larvae then dropped on to the tobacco and established themselves in the curled tips. Only those that were nearly full grown developed to the pupal stage on the tobacco, but when many larvae were present, the damage was severe. Four adults reared from larvae from Lilongwe were found to belong to a species of Crambid. Injury was not observed in sheds constructed from the previous season's grass.

SUBRAHMANYAM (V.). **Sugarcane Borer Control by the Egg Parasite, *Trichogramma minutum* R.**—*Mysore agric. Cal.* 1941-42 pp. 12-13, 1 pl. Bangalore, 1941.

The mass rearing of *Trichogramma minutum*, Ril., at Mandya and its release in sugar-cane fields in this area [cf. *R.A.E.*, A 25 479] have been carried out on a progressively increasing scale. The releases have resulted in up to 90 per cent. parasitism of eggs of *Proceras (Argyria) sticticraspis*, Hmps., and *P. (Diatraea) venosatus*, Wlk., in areas where the initial parasitism was 0-13 per cent., and statistical analysis showed them to cause a significant increase of about three tons sugar-cane per acre in 1938. Parasites that were sent by post in 1937-39 and released in Orissa and Bihar were stated to have proved of value in the control of the borers.

SUBRAHMANYAM (T. V.). **The Jola Grasshopper or the Deccan Grasshopper (*Colemania sphenaroides* Boliv.).**—*Mysore agric. Cal.* 1941-42 pp. 27-28, 3 pls. Bangalore, 1941.

Outbreaks of *Colemania sphenaroides*, Bol., occur in the north and north-west of Mysore at intervals of 10-15 years and cause serious damage to sorghum, *Eleusine coracana*, *Pennisetum typhoideum* and *Setaria italica* sown during the south-west monsoon rains. The same scattered areas are always affected, and the damage is greatest during the third and fourth years of an outbreak, slight in the fifth year, and then ceases until the next outbreak. As 1941 was the third year of an outbreak of the grasshoppers, serious damage was anticipated soon after the beginning of the south-west monsoon rains, and a list is given of areas found infested in 1940.

Control measures recommended are dragging a bag rapidly over the crop by hand and drowning the insects caught in water containing a little kerosene, catching them in a more elaborate bag drawn by bullocks [cf. *R.A.E.*, A 21 152] and dusting the grass strips between fields, on which the young of grasshoppers that hatch during the south-west monsoon rains are usually found for some time, with calcium arsenate or Paris green.

HELY (P. C.). **The Citrus Green Tree Hopper (*Caedicia strenua* Wlk.). A Cause of Rind Marking and Scarring.**—*Agric. Gaz. N.S.W.* 56 pt. 4 pp. 166-168, 178, 2 figs. Sydney, 1945.

Scarring of the rind of *Citrus* fruits is common throughout New South Wales and may be considerable in some seasons. It may be caused by Tettigoniids of the genus *Caedicia*, by thrips or by the abrasive action of leaves and twigs on

young fruits. Many native species of *Caedicia* occur on a large variety of trees and shrubs in the State, and several have occasionally been taken on *Citrus*, but the only ones that damage the fruits are *C. strenua*, Wlk., in the coastal areas and *C. simplex*, Wlk., inland. Adults of *C. olivacea*, Burm., are common in coastal *Citrus* orchards in spring, but the injury they cause is slight and confined to the tender foliage.

An account is given of the appearance and bionomics of *C. strenua* and of the damage it causes; the general features apply also to *C. simplex*. There is one generation in the year. The eggs, which are sometimes found among mossy growth in the crotch of the trunk of *Citrus* trees, are deposited in groups of about twelve in late summer and autumn, and hatch the following spring. Oviposition has been recorded from January to April, but probably continues later, and young nymphs were first observed in early September. The nymphs feed mainly on the upper surface of the young foliage at first and then on the young fruits as they appear. The fruits become unattractive as they grow, and those of about the size of a walnut are not attacked by either nymphs or adults. Adults appear in December and January, but do not cause much damage. Second-crop fruits may be nibbled by them, but the main crop is usually too advanced to be attractive. The nymphs feed in small groups, but the adults occur singly or in pairs. Adults have been collected on a wide variety of plants, and *Eucalyptus* was probably the original food-plant. *Citrus* is probably a major food-plant, blackberry is an important one, and both *C. strenua* and *C. simplex* attack other cultivated fruits, particularly peaches and plums.

Parasitism of *C. strenua* has not been observed, though Tachinids have been recorded from *C. olivacea*. Effective control has been obtained by a spray of 1½ lb. lead arsenate in 40 gals. water or 1½ lb. cryolite and 1 quart white oil in 40 gals., applied to the outer foliage and fruit when injury first becomes apparent or just after the petals have fallen. Lead arsenate, however, is not recommended for use on *Citrus*. Cryolite should not be mixed with Bordeaux mixture, which reduces its toxicity. Dusts of cryolite, barium fluosilicate and lead arsenate in kaolin were very effective in limited tests.

WALLACE (C. R.). **D.D.T. as a Soil Dressing against Black Beetle.**—*Agric. Gaz. N.S.W.* 56 pt. 4 p. 186. Sydney, 1945.

Laboratory tests in New South Wales in 1944 having shown that DDT was very toxic to adults of *Heteronychus sanctae-helenae*, Blanch., even when mixed with soil at a concentration of less than 1 : 1,000, preliminary field experiments were carried out in February and March 1945 with crops of cauliflowers and marigolds on farms on which the beetles were abundant and destructive. The seedlings were set in holes made with a planting stick, and these were then filled with fine soil mixed with dust containing DDT. After the plants were firm, more treated soil was put round them at the surface to form a patch about 6 ins. in diameter. The concentrations used (1½–3 parts DDT per 1,000) had no obvious ill-effect on the growth of the plants. The proportion of plants showing the usual damage caused by the beetles below ground [cf. *R.A.E.*, A 28 46] was relatively very high in untreated plots, and the injury was severe, often killing the plants, but such damage was absent or insignificant in treated ones. Some of both treated and untreated plants showed marks of beetle feeding above ground level, but this seems to be commercially unimportant.

DICK (R. D.). **Ecological Observations on *Oxycanus cervinata*.**—*N.Z.J. Sci. Tech.* 27 (A) no. 1 pp. 32–36. Wellington, N.Z., 1945.

Observations on the flight of *Oxycanus cervinatus*, Wlk., were made in North Otago, New Zealand, from 9th October to 2nd November 1940 by means of a

light-trap placed 3 ft. above the ground and operated from 7 p.m. until 10.30 p.m. The evening temperatures ranged from 41 to 71°F. and moths were caught each evening. The total number taken was 9,406 and the largest catch (3,000) was on a single evening at 49.5°. The catches were large at various temperatures between 47.5 and 71°, inclusive, but only single moths were taken at less than 45°. There was some evidence that large flights tended to follow days on which the air temperature had been high. There was no obvious relation to humidity, large catches being made at relative humidities ranging from 50 to 90 per cent. Large numbers of moths were caught on calm evenings or when there was only a slight breeze, but 79 were caught on 24th October during a period of strong north-west wind. Observations in the field indicated that few moths were on the wing during an evening when a medium to strong wind was blowing.

Large flights appeared to follow large emergence on the same evening. As the number of moths that emerge depends on the number of pupae that have completed development, and this depends chiefly on soil temperature, emergence may be large after a day of high soil temperature. There is possibly some factor, perhaps light intensity, that causes emergence to occur at about 7-8 p.m.; humidity seems to be unimportant. No emergence was observed on nights of medium to strong wind. About 70 per cent. of the moths caught were females. It appeared that the males emerge earlier than the females and fly for a shorter period, being most abundant between 7.30 and 8 p.m. Most females mated soon after emergence and began to oviposit 2-30 minutes later. The eggs are usually deposited singly at random on the ground or on pasture plants, and the females fly little until after oviposition. Six females caught immediately after mating laid an average of 756 eggs each in glass tubes.

There was no indication of mass migration, but some movement took place to good pasture from pasture that had been denuded by the larvae.

COTTIER (W.) & JACKS (H.). **Relative Efficiencies of Nicotine Sulphate and certain Arsenates for Control of Diamond-back Moth.**—*N.Z.J. Sci. Tech.* 27 (A) no. 1 pp. 37-39. Wellington, N.Z., 1945.

Two preliminary field tests on the control of *Plutella maculipennis*, Curt., on cabbage by means of sprays containing nicotine sulphate, lead arsenate or calcium arsenate were carried out in New Zealand in 1940. A commercial wetting agent was added to all sprays. In the first test, treatments were applied on 9th and 31st January and 15th and 28th February under conditions of heavy infestation to cabbages planted on 20th December, and the plants were divided into those with damaged and undamaged hearts on 14th-19th March. As compared with the controls, nicotine sulphate gave highly significant increases in the numbers of uninjured hearts at concentrations of 1:200 and 1:400, significant increases at 1:600 and a non-significant increase at 1:800 when applied at the rate of about 110-165 gals. per acre, but sprays of 2, 3 or 4 lb. lead or calcium arsenate per 100 gals. water, applied at about 125-195 gals. per acre, gave little or no increase. Calcium arsenate injured the plants at all concentrations, and lead arsenate at the highest.

In the second test, single rows of 30 cabbages planted on 23rd January were sprayed five times at intervals of seven days from 28th February, when they were already considerably damaged by *Plutella*, and examined for injury on 14th April. Nicotine sulphate (1:200, 1:400, 1:600 and 1:800), applied at approximately 60-190 gals. per acre, gave averages of 15, 11, 7 and 4 marketable heads, as compared with two and none, respectively, for 3 lb. lead and calcium arsenate per 100 gals., applied at about 95-190 gals. per acre, and none on untreated rows. The two highest concentrations of nicotine sulphate were the only treatments that gave significant results.

DUMBLETON (L. J.). **Bacterial and Nematode Parasites of Soil Insects.**—*N.Z.J. Sci. Tech.* **27** (A) no. 1 pp. 76–81, 2 refs. Wellington, N.Z., 1945.

This is a preliminary report of the occurrence in New Zealand of a native bacillus causing a milky disease of *Odontria zealandica*, White, and of work there with *Bacillus popilliae* and the Nematode, *Neoapectana glaseri* [cf. *R.A.E.*, A **29** 369–370], which were imported from the United States. In preliminary experiments with spore cultures of *B. popilliae* and a dust of the spores in talc, received in March 1941, the disease developed in nine days or less in 2 of 40 larvae of *O. zealandica* that were kept in infected soil, 6 of 20 that were pricked with an infected needle, and 7 of 30 that received injections of spore suspensions.

Work with *B. popilliae* was suspended on the discovery of a native bacillus, morphologically similar to it, but not identical, which also caused a milky disease of the larvae of *O. zealandica* and at least one other species of *Odontria*, but gave negative results when tested in the United States on those of *Popillia japonica*, Newm., and *Lachnosterna* (*Phyllophaga*) *hirticula*, Knoch. The spores are presumably ingested with soil, and though larvae in the later stages of infection assume the characteristic milky colour, due to the presence of a dense culture of spores, those in the earlier stages, which contain rod-like forms, are indistinguishable from healthy larvae. At the end of March, infected larvae were smaller than healthy ones, which indicates that the disease retards growth and kills fairly slowly. In an experiment on infection, a suspension of spores from diseased larvae of *O. zealandica* was injected into 18 healthy ones on 2nd April 1941. The larvae were kept in soil and examined from time to time. One had died in 38 days and showed rod forms in the blood, and another six showed rods or spores after periods ranging up to 68 days, though only one of the four found infected after 68 days had died. Two were still healthy at the end of the experiment, and the remaining nine were not recovered.

The disease is apparently widely distributed, at least in the South-Island. At Nelson, 79 per cent. of larvae taken in the field in April 1941 were in the top inch of soil and about 38 per cent. of all larvae taken were infected, as were 25 per cent. of all larvae collected on 17th March 1945. In April 1945, diseased larvae were found in Ashburton County, where soil temperatures were lower, but they represented a smaller proportion of the population, and the disease is apparently of little importance there. It does not seem to prevent the development of destructive numbers, as high grub populations are widespread in this area and serious damage to pastures is frequent. The disease is also present in the field at Seddon.

In trials with larvae in soil infected with *Neoapectana glaseri*, a culture of which was received in 1945, 3 of 7 larvae of *Oxycanus cervinatus*, Wlk., 7 of 18 of *Odontria zealandica*, 3 of 7 of an undetermined species of *Odontria* and 1 of 6 of *Calonota* (*Pyronota*) *festiva*, F., were attacked and died in 2–7 days. When the Nematode culture was injected orally into *Oxycanus cervinatus*, 1 of 5 larvae became infected and died in 4 days, but when it was injected into the body cavity of 5 larvae, none was affected. A larval suspension on the mouth-parts had no effect on 8 larvae of *Odontria* sp. The Nematode was established on culture media.

KELSEY (J. M.), SPILLER (D.) & DENNE (R. W.). **Biology of *Anobium punctatum*.** **Progress Report.**—*N.Z.J. Sci. Tech.* **27** (B) no. 1 pp. 59–68, 3 figs., 13 refs. Wellington, N.Z., 1945.

The literature on *Anobium punctatum*, Deg., in New Zealand is briefly reviewed and details are given of the techniques employed in breeding it for use as a test insect in the evaluation of wood preservatives, with notes on aspects of its biology observed in the course of the work. Adults of the

Pteromalid, *Theocolax formiciformis*, Westw., were commonly observed during the flight period of *Anobium*, and large numbers of the ectoparasitic Tarsenomid, *Pediculoides* (*Pyemotes*) *ventricosus*, Newp., were sometimes found when infested timber was dissected for larvae; the importance of these two parasites in the control of the beetle is not known.

Investigation showed that males and females of *A. punctatum* occurred in approximately equal numbers, though the proportion of females caught was often low, since they spend less time on the surface of the wood than they do ovipositing in holes and crevices in it. There was some evidence that females may mate three or more times in the course of egg-laying. In oviposition experiments, the physical nature of the wood surface was as important as the species of timber, the chief factor governing choice of a site being the opportunity of wedging the egg firmly into a small hole or crevice. Eggs were always attached to the surface by an adhesive, even when wedged into crevices. The egg stage varied from six to ten days on wood, but lasted as long as five weeks in the case of eggs deposited on muslin. The larvae emerged from the egg surface in contact with the timber and began to tunnel into the wood with the capsule still in place, but when an egg was cemented to a smooth flat surface the larva was often unable to begin tunnelling and remained in the egg. When kept at 22.5°C. [72.5°F.], no eggs hatched at a relative humidity below 45 per cent., 54-80 per cent. hatched at 50-65 per cent. humidity, and over 80 per cent. at higher humidities.

Sapwood of kahikatea (*Podocarpus dacrydioides*), which is highly susceptible, was used for all work other than that on the susceptibility of different timbers, and experiments with it indicated that the life-cycle lasts three years. In timber examined 18 months after infestation, the tunnels in rimu (*Dacrydium cupressinum*) and matai (*P. spicatus*) were much smaller than those in kahikatea and larvae in totara (*P. totara*), which is not normally susceptible, had died when their tunnels were  $\frac{1}{2}$  in. long. In another experiment, larvae in rimu and matai were as small after 16 months as were those in kahikatea after six.

Two instances of infestation of materials other than timber are recorded. In the first, a wood-fibre wallboard infested with eggs in the laboratory contained live larvae and normal frass after 14 months. In the second, extensive tunnels made by the larvae were found in the cardboard filling of a leather suitcase, as well as exit holes in the leather, and adults of *A. punctatum* emerged from it.

KELSEY (J. M.). **A Termite damaging Coconut-palms on Suwarro Island :** *Calotermes* (*Neotermes*) *rainbowi* Hill.—*N.Z.J. Sci. Tech.* **27** (B) no. 1 pp. 69-75, 3 figs., 3 refs. Wellington, N.Z., 1945.

The author describes the alate and soldier of a termite that caused such severe damage to coconut palms on Suwarro, one of the Danger Islands [in the Northern Cook Group] that large numbers of the trees were snapped off by gales in 1941, and gives characters in which Hill's descriptions [*R.A.E.*, **A** 31 324] of the alate and soldier of *Kalotermes* (*Calotermes*) *rainbowi*, Hill, and of the soldier of *K. (C.) samoanus*, Hlmg., differ from them. In spite of these differences, T. G. Greaves considers that there is little doubt that the termite is *K. rainbowi*, and the author therefore uses this name for it.

It is suggested that the termites could be controlled by drilling holes into infested limbs and blowing small quantities of an arsenic dust into them by means of a syringe, as this method has proved effective against species of *Kalotermes* and *Coptotermes* in tea bushes in Ceylon [cf. **18** 105]. Attack should be prevented by covering all scars and injuries with a coating of paint, resin, tar or asphalt; an adhesive might be used to prevent access to dead heartwood of the trees by way of breaks in the living tissue.

HAVELKA (J.). Příspěvek k poznání výskytu *Ptinus* (*Pseudobruchus*) *tectus* Boield. v naší fauně. (Coleoptera, Ptinidae.) [Contribution to the Occurrence of *Ptinus tectus* in our Fauna.]—*Věda Přír.* 23 no. 6 pp. 181–182. Prague, 1945.

*Ptinus tectus*, Boield., was recorded as new to Czechoslovakia in 1941, but K. Pfleger informed the author that he took this beetle in Prague in 1940 and 1941, and again in 1942 when about 300 examples were found among dry ants' pupae in a closed glass cylinder. Two examples were also collected by him in another locality in 1943. In October 1944, the author found a number of living larvae and a few adults of *P. tectus* among the ants' pupae, together with numerous dead examples of *Sitodrepa panicea*, L. From a survey of the localities in which *P. tectus* was found, he concludes that it must be of fairly frequent occurrence in Czechoslovakia.

VAN DEN BRUEL (W. E.). A propos de la lutte contre les mouches de la chicorée de Bruxelles *Napomyza lateralis* Fall. et *Ophiomyia pinguis* Fall. Nouvelles observations sur le traitement à l'eau chaude et sur l'appareillage nécessaire.—*Bull. Inst. agron. Gembloux* 10 no. 1–4 pp. 26–52, 4 figs., 8 refs. Gembloux, 1941. (With Summaries in Flemish, German and English.)

Further experiments on the hot-water treatment for the control of *Phytomyza* (*Napomyza*) *lateralis*, Fall., and *Agromyza* (*Ophiomyia*) *pinguis*, Fall., infesting roots of chicory in Belgium [*R.A.E.*, A 26 313; 28 539; 33 120] were made in 1939–40 and 1940–41. The tests were on a larger scale than the previous ones and the apparatus employed in the second year, which is described, enabled at least 200 roots to be treated simultaneously and was designed to provide a model for equipment for use on a commercial scale. In the second year, the treated roots were afterwards forced, but in the first year they were not. The tests confirmed previous findings that immersion for 1½ hours in water kept at 40°C. [104°F.] is an effective and practicable method of control of these Agromyzids. The quality of the blanched heads is not impaired by the treatment, and their growth is accelerated so that the duration of the forcing period can be shortened. Immersion for two hours at 40°C. had no deleterious effect provided that the roots were firm when treated, but when they had become soft the results were less satisfactory, though the yield was not lower than that from untreated roots. Yield was slightly reduced following immersion for 1½ hours at 41°C. [105.8°F.], and immersion for two hours at 40.5°C. [104.9°F.] caused an appreciable reduction. Immersion for more than two hours, or for 1½ hours at temperatures higher than 41°C., was injurious. The treatment can be carried out immediately before forcing, and roots that have begun to sprout are not damaged by it, provided that they are in good condition. Exposing the roots to excessive treatment stunts the growth of the central leaves of plants that are not subsequently forced and causes the production of long heads and flower stems by those that are. The cost of the treatment is discussed; it appears to be economically practicable and is to some extent offset by the reduction in the period required for forcing. Infested blanched heads should be kept at temperatures as low as possible in order to check the activity of the larvae. Experiments showed that this is greatly reduced at 0–2°C. [32–35.6°F.], but that some continues even at temperatures a little below freezing point. Damage is most likely to be severe when the heads are kept at 4.5–8.5°C. [40.1–47.3°F.], since the larvae are then active and remain so for some time, whereas at temperatures of 20°C. [68°F.] and higher they soon pupate.

When infested plants from the neighbourhood of Brussels were examined on 23rd October 1941, both species were found to be present, but *P. lateralis* comprised only 7 per cent. of the individuals present; 10 per cent. of the larvae had pupated and of those that were still active, 3 per cent. were in the first instar, 9 per cent. in the second and the rest in the third. Most of the larvae were in the bases of the petioles, 23.8 per cent. were in the leaves and 12.7 per cent. in the collar and roots. Larvae in the bases of the petioles at the centre of the plants are less likely to be destroyed by the treatment and those found in the heads produced by treated roots have evidently survived in this way. It was stated by one grower that infestation is lowest in plants lifted at the beginning of the season and that larvae do not become numerous until the end of December.

MAYNÉ (R.) & BRENÉ (R.). *Prédateurs et parasites du doryphore*.—*Bull. Inst. agron. Gembloux* 9 no. 1–4 pp. 61–80, 8 figs., 19 refs. Gembloux, 1940. (With Summaries in Flemish, German and English.)

It is shown from a brief review of the literature that though attempts have been made to introduce natural enemies of the Colorado potato beetle [*Leptinotarsa decemlineata*, Say] into Europe, and it has been attacked there by various indigenous Arthropods and (in Belgium) by an entomogenous fungus, none of them has appeared likely to be of value in its control [cf. R.A.E., A 26 594; 28 447; 29 70, etc.]. In view of the finding of a nymph of *Picromerus bidens*, L., attacking a larva of *L. decemlineata* in Belgium in 1940, various predaceous Pentatomids were collected in two provinces during July–October and reared in the laboratory. Of these, *P. bidens*, *Troilus luridus*, F., *Zicrona coerulea*, L., and *Eysarcoris* (*Asopus*) *punctatus*, L., attacked larvae of *L. decemlineata* most readily, and the results of studies on the bionomics of the first two, which appeared the most promising, are recorded.

*P. bidens* occurs in cool, damp or marshy habitats with abundant vegetation, and high humidity appears to be essential for it. It feeds almost exclusively on insects, preferring those that are slow-moving and have firm bodies and a smooth, thin cuticle. In the laboratory, it fed on larvae of *Pieris brassicae*, L., and *Mamestra brassicae*, L., as readily as on those of *L. decemlineata*. One adult frequently attacked three or four *Leptinotarsa* larvae per day, and the younger nymphs fed on larvae in the first or second instar. The numbers of larvae destroyed by an individual bug is increased by the fact that it often sucks only a little of the body-fluid from each. This Pentatomid has one generation a year, and overwinters in the egg stage. The eggs hatch in May or June, and the nymphs pass through five instars, of which the first, in which no feeding occurs, is short. The adults appear during the first fortnight of August, oviposit from the last fortnight of August until the first frost, and die before winter. In the laboratory, mating and oviposition took place readily at 16°C. [60–8°F.], but no eggs were laid at 14.5°C. [58.1°F.].

*T. luridus* was found in much the same type of habitat as *Picromerus*, and its feeding habits and food preferences were similar, but it is less active, consumes rather less, and generally removes all the fluid from its prey. When adults of both Pentatomids were fed on larvae of *Pieris* and *Mamestra* that were infected with polyhedral disease, mortality among them was high. Warm, moist conditions favoured the activity of *T. luridus*, which appeared to be influenced most by moisture. Adults have been found in Belgium in each month from June to September, but the authors consider it probable from their collecting records that the bugs become adult in early September and survive until the end of the following summer and that there is only one generation a year. The nymphal period occupied about three weeks at 25–26°C. [77–78.8°F.] and a relative humidity of nearly 100.

BRENY (R.). **Observations sur les sorties printanières du doryphore en 1941 dans la région de Gembloux.**—*Bull. Inst. agron. Gembloux* 10 no. 1-4 pp. 147-151, 3 graphs, 1 ref. Gembloux, 1941. (With Summaries in Flemish, German and English.)

In 1941, the weather in the district of Gembloux was mild from 28th February to 17th March, the soil temperatures, taken at a depth of 4 ins. at 8 a.m., averaged 3.7°C. [38.66°F.], and the last week of the period was sunny. Emergence of the overwintered adults of *Leptinotarsa decemlineata*, Say, began on 17th March, when the soil temperature was 4.6°C. [40.28°F.], and was continuous during over a month's observations, despite the occurrence of two short spells of relatively cold weather about 21st March and 8th April. It is probable that the beetles were moving upwards from the deeper layers of the soil during the warm weather in the first half of March, and it thus appears that after they have moved upwards in the soil they can emerge from it even if the temperature falls below the minimum required for emergence to begin, since the surface layer of the soil becomes warm enough during the day to induce the activity necessary for them to emerge.

HUBAULT (E.). **Un parasite non encore signalé des aiguilles du sapin blanc (*Abies alba* Mill.).**—*Bull. biol.* 79 fasc. 1 pp. 17-30, 4 pls., 9 figs., 4 refs. Paris, 1945.

Investigations showed that yellowing of the needles of young silver fir (*Abies alba*) first noticed in the autumn of 1942 and observed in several forests in Haute-Marne, France, was due to a Cecidomyiid, *Agerivillea abietis*, gen. et sp. n., of which the egg, larva and adults are described. The adults appear in late April and early May, and the eggs are laid singly on the young needles when the buds are opening, usually on the upper surface. The newly hatched larva moves to one of the two lines of stomata that are situated one on each side of the central vein; in this position it becomes embedded in the tissues in the course of a day through a slit which forms in the epidermis beneath it. No gall is formed, but the slit increases in size. The larva leaves the needle through it in December and pupates in débris on the ground, apparently without a cocoon.

An infested needle, which may contain one or more larvae, becomes discoloured and deformed and falls in winter. On shoots that lose most or all of their needles, the terminal buds fail to develop or develop late; in the latter case they are still closed at the time of oviposition in the following year and escape infestation. Consequently, on branches that have been attacked for several consecutive years defoliated portions alternate with portions bearing needles, and this condition is characteristic of the infestation and is visible at a distance. Main shoots may die and young trees become stunted. The lower branches, and trees growing under a dense low cover, suffer most, and infestation of young trees in one forest was prevented when they were not allowed to become overgrown by other vegetation.

The larvae were attacked by an external Hymenopterous parasite, which oviposited in August. The infested needle did not fall, because the parasite larva prevented further damage by the host, and the larva pupated in it early in the following summer. The adult emerged through a hole made in the lower surface of the needle.

SIEGRIST (H.). **Untersuchungen über die Lauchmotte *Acrolepia assectella* und ihre Bekämpfung.** [Investigations on the Leek Moth, *A. assectella*, and its Control.]—*Promotionsarb. Eidgen. tech. Hochsch. Zürich*, 64 pp., 27 figs., 3 graphs, 20 refs. Olten, Verlag O. Walter A.G., 1945.

*Acrolepia assectella*, Zell., is injurious to leeks, onions and garlic in Switzerland and has been favoured by the increase in the cultivation of leeks during

the war. Control measures are urgently necessary, and investigations were therefore made by the author in 1944-45 on the bionomics of this Tineid and on the effectiveness of various insecticides against it.

The first three parts of this paper (pp. 13-32) contain information on the systematic position and geographical distribution of *A. assectella*, a table showing the distribution in Europe of 18 species of *Acrolepia* and the food-plants, frequency of occurrence and flight seasons of most of them, and detailed descriptions of all stages of *A. assectella* and of some of the internal organs of the adults and larvae.

In the fourth part (pp. 33-52) is given an account of breeding experiments in the laboratory, in which three generations were reared on leeks between mid-October 1944 and the beginning of April 1945. The adults did not feed on solutions of sugar or honey or an infusion of raisins, but imbibed the water that accumulated in the leaf-sheaths of the plants in the cages when they were sprayed. Moths that emerged from ten male and ten female pupae placed in a box mated readily, but those isolated in pairs in boxes of the same size did not. Oviposition began about three weeks after emergence, reached a peak 14-25 days later and continued until death. Males and females survived for averages of 54 and 68 days, and the latter laid an average of 80 eggs each. The eggs were deposited chiefly on the outer surface of the lower leaves and on the upper part of the stem, but frequently also on dry leaves, so that the larvae had to migrate before feeding. Oviposition ceased at temperatures below 9.5°C. [49.1°F.] and was delayed at 9.5-13°C. [49.1-55.4°F.]. The egg stage lasted seven days at 18°C. [64.4°F.] and the larval stage averaged 19 days at 18°C. and 13 days at 25°C. [77°F.]. The larvae abandoned the leaves three days before pupation and spun cocoons on the walls of the glass containers, while those kept under natural conditions did so on the lower sides of the leaves in places protected from rain.

The effect of temperature on the duration of the egg and the pupal stages was studied at 80 per cent. relative humidity. The lowest temperature at which the eggs and pupae developed was 7°C. [44.6°F.], the respective stages then lasting 40 and 58 days. Of batches of ten eggs, all hatched at temperatures of 7-26°C. [44.6-78.8°F.], several at 28°C. [82.4°F.], and none at 30°C. [86°F.] or above. The eggs proved resistant to short periods of cooling, and normal larvae hatched from eggs that were kept at 18°C. and exposed in January for 30 hours outdoors when the temperature ranged from -5 to -12°C. [23-10.4°F.] and averaged -8°C. [17.6°F.]. The pupal stage lasted nine days at 30°C., which was the highest temperature to which pupae were exposed. The life-cycle from oviposition to the peak of oviposition of the next generation was completed in 81 days at 18°C., the egg, larval and pupal stages lasting 7, 19 and 11 days, respectively.

Eggs of *A. assectella* were placed on 15 cultivated and wild species of *Allium*, which are classified in four groups according to leaf type. The larvae developed in all of them, but mortality was high on the group of species with delicate thin leaves, as the larvae could mine the leaves only in the first two instars and then passed into the base of the stem, and continued to develop chiefly in the underground parts of the plants.

The European literature on the life-history of *A. assectella* in the field [R.A.E., A 12 356; 16 283; 20 558] is reviewed, and an account is given of observations in northern Switzerland (Zürich and Aargau). There were two generations a year, the adults and some pupae of the second hibernating. The moths appeared at the beginning of May, and eggs were present from the beginning of June to the end of July. The egg, larval and pupal stages lasted 7-10, 19-25 and 11-12 days, and the first-generation adults emerged from mid-July to the beginning of September, and oviposited until the end of October. The first larvae of the second generation hatched in mid-August and pupated at the beginning of September, the adults emerging 16-19 days later. Most of

the moths of this generation emerged early in November, but some emergence occurred in mid-December. The eggs are susceptible to prolonged cold, and the larvae still more so, since they are easily killed by night frosts. Some of those that hatch late pupate before the onset of cold weather, and the others die. There is probably some mortality among the overwintering pupae and adults, since larvae of the first generation are always less numerous than those of the second.

The last section (pp. 53-61) deals with the injury caused and control. Damage by the first generation is usually moderate, and only 1.5-4 per cent. of the leeks in the districts surveyed were infested in 1944 and 1945. The plants soon outgrow the injury, and it was evident from examination of infested plants that the larvae did not penetrate to the central part, though those in the later instars mine in the flower stalks of garlic and onions and frequently cause them to break. Damage by the second generation is more serious and is aggravated by rotting associated with wet weather. In laboratory and field experiments, various proprietary sprays and dusts gave good control of the larvae, but the concentrations of the active ingredients are not stated. They comprised dusts and sprays containing DDT, a nicotine spray and a rotenone dust. Sprays were more effective than dusts, which were frequently washed off by rain. Three applications were not sufficient against a heavy infestation of second-generation larvae, and it is considered that sprays should be applied four times at intervals of 10-14 days, and dusts 5-6 times at intervals of 8 days, both from the beginning of August. A spray containing 0.05 per cent. nicotine gave high mortality of the eggs in the laboratory.

**PETHERBRIDGE (F. R.), STAPLEY (J. H.) & WOOD (J.). Wheat Bulb Fly Field Experiments.—Agriculture 52 no. 8 pp. 351-354. London, 1945.**

Damage to wheat by the wheat bulb fly [*Hylemyia coarctata*, Fall.] can be avoided by substituting other crops, such as winter oats, for wheat following potatoes, sugar-beet, or fallow [*R.A.E., A 33 297*], but in some districts this measure is impracticable because oats occupy a different place in the rotation, cover a smaller area, or tend to lodge when they follow potatoes. *H. coarctata* was very injurious in 1944 in a part of Lincolnshire, in which wheat commonly follows potatoes, and attempts were therefore made to discover a manurial or cultural programme that might be of value against it. The fields in which the experimental plots were situated had previously been under potatoes, and egg samples were taken from them at intervals from September, before ploughing, to mid-February, when most of the eggs were hatching. The eggs were fairly evenly distributed over the fields, and were most numerous at a depth of 0-3 ins. The effect of ploughing to depths of 4, 6 or 10 ins. appeared to be merely to distribute the eggs throughout the soil, but some indication was obtained in one field that ploughing to a depth of 10 ins. reduced the number within 3 ins. of the surface. The eggs were fully developed by the end of August, and there was little mortality among them during the autumn or winter. In two of the fields, the potatoes had not been harvested until September, but despite the coverage provided by the haulms in July, the egg populations were 500,000 and 700,000 per acre in September. The potatoes were cleared from the third field between mid-July and mid-August, and half of it was then sown with mustard [*cf. loc. cit.*] and the rest left fallow; the egg population in this field was 1,500,000, and eggs were as numerous in the half that had been under mustard as in the fallow. It is concluded that mustard is of little value as a cover crop for preventing oviposition and of none unless it is sown early enough to provide cover by July. Sampling showed that only dense cover crops, such as cereals or flax, can prevent oviposition, that many eggs are deposited before mid-July in fields under potatoes, and that the adults tend to migrate from the wheat fields in which they emerge. Estimates of

the degree of infestation of the wheat based on counts of the damaged stalks made in mid-March showed it to be correlated with the egg population. In one field, infestation was about the same on plants sown on 18th October and 6th December, but the stand of the early-sown crop was greatly superior to that of the late, which was ultimately ploughed up. In another field in which sowings were made in mid-November and early December, infestation was also fairly uniform, and there was little difference in stand. Infestation was lower on wheat following mustard, whether sown early or late, than on wheat following potatoes, and there was some indication that it was lower in plots that had been ploughed deeply. No benefit was obtained from an application of superphosphate of lime. On the basis of these experiments, sowing before November is recommended to reduce damage by *H. coarctata*; on fertile soil, it could probably be delayed until early November with satisfactory results.

**Report of the Federal Experiment Station in Puerto Rico, 1944.**—44 pp., 30 refs. Washington, D.C., 1945.

This report contains a number of papers dealing with investigations in Porto Rico on plants that are or may be sources of insecticides and on insect pests.

In **Relative Toxicity of Rotenone Plants** (pp. 9–10), M. A. JONES & W. A. GERSDORFF describe experiments in which the roots of *Lonchocarpus chrysophyllus* and two varieties of *Derris elliptica*, all grown in Porto Rico, and of *L. utilis* [cubé] collected in Peru, were analysed for rotenone and rotenoids and tested for toxicity to house-flies [*Musca domestica*, L.]. The samples of *D. elliptica* were more toxic than those of *Lonchocarpus* with the same rotenone content. *L. utilis* showed some toxicity due to extractives other than rotenone, but *L. chrysophyllus* practically none. It appeared from a comparison of the results of chemical analysis with the insecticidal values that the percentage of rotenone and rotenoids determined colorimetrically was the best estimate of the toxicity of the samples.

In **Losses of Rotenone during Storage** (pp. 10–14), M. A. JONES gives the results of an investigation to determine whether storing fresh derris root at high humidity for long periods would result in loss of rotenone or rotenone-type compounds. Whole fresh roots, 3–10 mm. in diameter and containing 66·8 per cent. water, were chopped into 2·5 cm. lengths and stored at room temperature in closed vessels for one or 14 days over water alone and over water solutions of 2 ml. ammonium hydroxide, 5 ml. hydrochloric acid or 10 ml. ethylene per 200 ml. Controls were dried immediately at 80°C. for half an hour and then alternately dried at 50° and desiccated over calcium chloride for 4-hour periods until constant weight was attained. The storage had no effect on total extractives, rotenone, red-colour value (total rotenone and rotenoids) or toxicity to house-flies, except for losses of up to 5 per cent. of dry matter from samples stored for 14 days. When the roots were stored for one or three months, dry-matter losses of 8–12 and 19–29 per cent. of the calculated original dry weight occurred. There was considerable variation in the amount of mould that appeared during storage and in the amount of hyperlenticular activity and the number of shoots and adventitious roots formed. Storage for one month resulted in some small losses and some small apparent gains in total chloroform extractives, and storage for three in 5–37 per cent. loss of the amount of extractives as compared with the control. Rotenone losses of up to 17 per cent. and from 13–44 per cent. occurred after storage for one and three months, and similar results were obtained for total rotenone and rotenoids. The losses were proportional to the amount of hyperlenticular activity and growth and inversely proportional to the amount of mould.

In an attempt to determine the effect of mould, one of two duplicate sets of four samples of fresh root was stored in a closed vessel for three months

over water or water containing bromine, with or without being first steamed for five minutes over boiling water in a closed container at atmospheric pressure. The samples of the other set were dried immediately or after steaming except that two were subjected to the bromine treatment for 16 hours. It was found impossible to prevent the growth of mould in the stored samples, but no hyperlenticular activity or development of adventitious roots occurred. Comparison with controls that had been dried at 105°C. to ascertain the moisture content of the fresh root and analysed showed no loss of dry matter among the samples dried immediately, though the steamed samples showed 10-13 per cent. loss of rotenone and those steamed and treated with bromine 5-8 per cent. loss; combined losses of rotenone and rotenoids were similar but smaller. After storage over water for three months, losses of dry matter and toxic constituents from the untreated sample were high. Steaming decreased them to some extent, but the bromine treatment was more effective, and the combination of the treatments practically eliminated the loss of toxic constituents as measured by extractives, rotenone and combined rotenone and rotenoids. It is concluded that the treatments were effective in proportion to the resultant degree of inactivation or killing of the enzyme system, and that the desirability of rapid drying of roots to prevent loss of rotenone-type compounds is indicated.

A modification of the red-colour test for rotenone-type compounds is described in which chloroform was used to extract the red colour in order to avoid error due to turbidity, which is considerable in some samples, particularly those containing oil, such as seeds of *Pachyrhizus*. The technique also serves as a confirmatory test for rotenone-type compounds. Thus a red colour that developed when flowers of *Pachyrhizus* were tested for rotenone but was due to compounds related to flavone or anthocyanin was not extracted on addition of chloroform. In tests to find whether any strain of *Pachyrhizus* spp. contains outstanding quantities of rotenone compounds, in which varieties introduced from China and Mexico were analysed, green beans showed a greater average content of rotenone and rotenoids per seed than mature beans. The seeds and pods of *Aeschynomene sensitiva*, which had been found to be positive to the Durham test for rotenone-type compounds [cf. R.A.E., A 26 224], were shown to contain little of this type of compound when the chloroform extraction technique was applied.

In **Plant Toxicology Studies** (pp. 15-16), H. K. PLANK describes investigations already noticed [33 339] showing the insecticidal properties of *Pachyrhizus erosus* and *Mammea americana*.

In **Cinchona Insects** (p. 21), H. K. PLANK & H. F. WINTERS report that *Scirtothrips longipennis*, Bagn., and *Anaphothrips orchidii*, Moul., were found heavily infesting the leaves of seedlings of *Cinchona officinalis* at Maricao; the first species was most abundant and probably caused a large part of the injury, which consisted of a rasping of the upper surface that caused the leaves to curl and die. Damage was slight on plants 6-15 months old in open beds under palm-leaf shade, but severe on 70-80 per cent. of those in beds more protected from the rain. The growth of the latter was considerably checked, and some of them died; leaves that outgrew the injury had much tissue killed along the midrib. Weekly spraying with nicotine sulphate (1:800) was necessary to control the infestation. The predacious thrips, *Franklinothrips vespiformis*, Crwf., was present in small numbers.

In **Insect Pests of Food Crops** (pp. 26-27), H. K. PLANK states that *Anticarsia gemmatilis*, Hb., and *Lamprosema (Hedylepta) indicata*, F., were largely responsible for the loss of 50-75 per cent. of the leaf area in several fields of the Seminole variety of soy bean; the greatest damage usually occurred when the plants were attaining full growth and sometimes resulted in approximately 25 per cent. loss of crop. Both species were active from July to late November and *Lamprosema* was present throughout December. Considerable parasitism

of *Anticarsia* by the fungus, *Spicaria prasina*, and two Tachinids, *Voria ruralis*, Fall., and a species of STURMIINI, and of *Lamprosema* by the Tachinids, *Nemorilla floralis*, Fall., *Sturmia cubaecola*, Jaen., and *Blondelia* (*Eucelatoria*) sp. and the Braconid, *Stantonia lamprosemae*, Mues., probably prevented greater loss. *Hymenia recurvalis*, F. (*fascialis*, Stoll), and *Psara* (*Pachyzancla*) *bipunctalis*, F., which occurred on the soy beans in early autumn, did some damage; the former, which was common on *Amarantus* spp., was parasitised by *Blondelia* (*Eucelatoria*) sp. In November–December, a Tineid of the genus *Brenthia*, probably *B. pavonacella*, Clem., skeletonised the under side of the lower leaves of many half-grown soy-bean plants, destroying more than half the leaf area in one field, and this injury and subsequent drought were estimated to have reduced the crop by about 30 per cent. Adults of *Cerotoma ruficornis*, Ol., were present, but caused comparatively light and sporadic injury.

K. A. BARTLETT in *Insect Parasites and Predators* (pp. 27–28) reports that two shipments of *Hambletonia pseudococcina*, Compere, a parasite of the pineapple mealybug (*Pseudococcus brevipes*, Ckll.) [cf. 32 342], were sent to Florida during the year. Over 480 adults were obtained from this material and liberated in the State. One adult of *Thysanus niger*, Ashm., was also reared from it; it is uncertain whether this Encyrtid is a primary or secondary parasite. Parasites of *Diatraea saccharalis*, F., received from São Paulo, Brazil, consisted of 1,388 examples of *Theresia claripalpis*, Wulp (*Paratheresia diatraeae*, Brèth.), 65 of *Metagonistylum minense*, Tns., and 1 of *Leskiopalpus famelicus*, Wied., which has been reported as a parasite of *D. saccharalis* in Trinidad. Adults of *Theresia* and *Metagonistylum* were liberated in February. The introduced Coccinellids, *Egius platycephalus*, Muls., *Chilocorus cacti*, L., and *Cladis nitidula*, F., gave effective control of *Asterolecanium bambusae*, Boisd., and *A. miliaris*, Boisd., on bamboo during the year, one- and two-year old culms being practically uninfested, whereas infestation was previously heavy on more than half the culms of this age; a similar condition existed in the case of bamboo foliage. *E. platycephalus* was the most effective, particularly as it was able to maintain itself under conditions of extremely light scale infestation.

In *Bamboo Powder-post Beetle* (p. 33), H. K. PLANK gives the results of further investigations on the susceptibility of bamboo wood to attack by *Dinoderus minutus*, F. [cf. 33 312], in which the influence of the moisture content and density of the wood at the time of exposure to attack of pieces of first-year uncured culms of 11 species was tested. In eight of the species there was a tendency for high initial moisture content to be accompanied by high susceptibility, but the correlation was statistically significant in only four of them, and in these the parts containing most moisture also contained most starch. In nine species there was a tendency for low specific gravity to be correlated with high susceptibility, but this was significant in only three species; in these, which were all generally low in starch, the parts with the lowest specific gravity were relatively high in starch. It was concluded that in the species tested, high initial moisture content and low specific gravity of the wood increased susceptibility to *D. minutus* only in individual species containing little starch, their effect tending to be obscured as the starch content of the wood increased.

GARMAN (P.). *A Study of Stickers for Lead Arsenate Sprays on Fruit Trees.*—*Bull. Conn. agric. Exp. Sta.* no. 485 pp. 107–161, 21 figs., 39 refs. New Haven, Conn., 1945.

The main object of this study was to provide adequate protection for apples in Connecticut with fewer spray applications than are commonly recommended. Since 1939, experiments have been directed towards the conclusion of spraying soon after petal-fall by applying the same quantities of insecticide and fungicide in the pink spray, calyx spray and one or two cover sprays as are

usually contained in pink and calyx sprays and several cover sprays and treatments against the apple maggot [*Rhagoletis pomonella*, Walsh]. It was considered that ceasing all spray operations after 15th June should ensure a low residue on the fruit at harvest, and the inclusion of adhesives and safeners continuous protection for fruit and foliage throughout the season. It is pointed out that adhesives for lead arsenate should cause no increase in spray injury, should spread reasonably well and provide a thick layer of poison on fruit and foliage, and should not reduce the effectiveness of the insecticide and fungicide ingredients, both of which are required in fruit sprays. The adhesive materials were therefore studied from the standpoint of the spray mixture as a whole.

Laboratory experiments, in which glass slides and the foliage on small shoots were treated by atomising the materials to be tested in a settling tower, drying and washing, are described. Since evaluation by any one method proved difficult, especially where the tenacity of the different adhesives was nearly equal, several techniques were employed in the tests with glass slides; these consisted of varying the amounts of adhesive, spray deposit or washing and keeping the other factors constant. Varying the amount of adhesive seemed the best method of determining the quantity needed for maximum adhesion. Foliage tests consisted of a similar type of experiment based on visual examination (if the deposits were readily seen) or on chemical analysis. Usually the results of slide and foliage tests were in reasonable agreement, and it appeared to be practicable to eliminate poor adhesives by slide tests, but the results for some materials were confusing. In general, soaps and related materials gave poor or harmful results by reducing adhesion, and flour and skim milk used alone did not improve the adhesion of spray mixtures to any extent. Wyoming bentonite with skim milk, casein or gelatin improved the adhesion of lead arsenate, fused bentonite-sulphur with lime was also beneficial, and alumina (aluminium hydroxide) gel, used at the rate of 50-60 per cent. of the total solids, gave a definite improvement. Oils generally improved adherence to foliage, and combinations of alumina gel and oil were particularly lasting, the addition of skim milk as a spreader apparently having no effect on their efficiency. Spray mixtures containing sulphur adhered best when fused bentonite-sulphur with lime or bentonite with casein was added; oils were generally incompatible. Mixtures containing Fermate (ferric dimethyldithiocarbamate) seemed to adhere better with white petroleum oil, alumina gel and skim milk than with the same oil, bentonite and skim milk, but the use of vegetable oils, such as soybean oil, with bentonite and skim milk prevented the flaking from the leaf surface that occurred when the mineral oil was used with them. Hydrated lime is useful as a safener, but may be detrimental to adhesion; it appeared, however, to be slightly beneficial at low concentrations with a moderate washing. In general, materials that adhere well to foliage also remain on the fruits, and these conclusions would therefore generally apply to fruit as well as foliage.

Field experiments on the basis of these results included small-scale tests to determine what materials adhered well to foliage and fruit. The results indicated a definite increase in adhesion for oils such as fish, perilla and soybean oil. Mixtures containing bentonite and skim milk powder or alumina gel and skim milk powder were next best in adhesion. In more detailed investigations on the control of insects and apple scab, schedules of a few sprays containing high concentrations of lead arsenate with adhesives and schedules of more sprays with lower concentrations and no adhesive were compared. In 1940-43, better control of the curculio [*Conotrachelus nenuphar*, Hbst.] was obtained with long schedules than with short ones, but in 1944 it was evident that three sprays of 6 or 9 lb. lead arsenate per 100 U.S. gals. were better than seven sprays of 3 lb. lead arsenate. The addition of  $\frac{1}{4}$  lb. manganese borate and  $\frac{1}{2}$  lb. soybean flour to a spray of 3 lb. lead arsenate and

5 lb. dry flotation sulphur per 100 U.S. gals. improved the control of *C. nenuphar* in a long schedule. Sprays that deposited heavy loads of lead arsenate that persisted on the foliage gave the best protection against *Rhagoletis pomonella*, and all reduced schedules caused a decided improvement in control, evidently because there was more arsenic on the leaves throughout the season. In 1943, three sprays containing  $1\frac{1}{2}$  lb. alumina gel,  $\frac{3}{4}$  lb. Fermate and  $\frac{1}{2}$  U.S. gal. white oil per 100 U.S. gals., with 3 lb. lead arsenate in the first (pink spray) and 6 lb. in the other two (calyx and first cover sprays) reduced the figures for percentages of apples infested by 12-31 as compared with five sprays of 3 lb. lead arsenate and 5 lb. dry flotation sulphur per 100 U.S. gals. It is considered probable that in years of heavy maggot infestation it may be advisable to supplement the short schedules with non-arsenical sprays or dusts, such as rotenone or DDT, at about the beginning of August. The extended schedule with sulphur fungicides resulted in large populations of the European red mite [*Parateiranychnus pilosus*, C. & F.], whereas the shortened one containing no sulphur did not. Scab control by Fermate was satisfactory with the reduced programme, but the seasons during which tests were carried out were drier than usual. Spray russetting was lower with the reduced schedule than with the long one.

The schedules of 3-4 sprays of double lead-arsenate dosage with adhesives provided a heavier arsenical deposit on the leaves throughout the season than the more extended ones. The arsenical residues appeared to be lower on the fruit than on the leaves, and none of those on fruit receiving the heavy dosage and shorter schedule were over the legal tolerance (0.25 grains  $As_2O_3$  per lb.) at harvest except during the dry season of 1944.

From the results of these experiments, the author concludes that lead arsenate adheres better alone than with dry flotation sulphur or flotation sulphur and lime and that the addition of lime improves the adhesion of lead arsenate on glass slides, but not on foliage, especially at high concentrations. Oils are good deposit builders and adhesives if the amounts used are in proportion to the amount of solids in the spray mixtures. Wyoming bentonite with 20 per cent. skim milk or casein is almost as good as oils and equalled them in a dry season. Alumina gel is a good adhesive, and various compounds that were used in the course of the experiments evidently produced some form of aluminium gel. These gels, including Wyoming bentonite (hydrated aluminium silicate containing about 16 per cent.  $Al_2O_3$ ), act as safeners for both oil and lead arsenate and prevent scorching of foliage even when the arsenic is retained on the leaves in large amounts over a long period. It is considered that by using adhesives that are good deposit builders and also safeners, the total number of sprays needed may be reduced considerably in seasons such as 1943 and 1944. In Connecticut, the reduced schedules have the advantage of a reduction in damage by *P. pilosus* and *R. pomonella* and in spray russet, foliage scorching and leaf drop, as well as in labour and expense. The main objections are the difficulty of handling the complex mixtures and the rather poor control of *C. nenuphar* when it is abundant. No difficulty was found in controlling the codling moth [*Cydia pomonella*, L.] with the reduced programmes and increased dosages of lead arsenate, but their use may not be advisable when the moth becomes a threatening factor in fruit production in the State. It is believed that reduced programmes may have a definite value in Connecticut for varieties of apple resistant to scab, but they have not been tested sufficiently in wet years to warrant recommendation for susceptible varieties.

PATCH (L. H.) & EVERLY (R. T.): **Resistance of dent Corn inbred Lines to Survival of first-generation European Corn Borer Larvae.**—*Tech. Bull. U.S. Dep. Agric.* no. 893, 10 pp., 1 fig., 1 ref. Washington, D.C., 1945.

Further investigations on the development of strains of dent maize resistant to first-generation larvae of *Pyrausta nubilalis*, Hb. [R.A.E., A 31 91] were

carried out in Ohio in 1938-41 inclusive, the plants being artificially infested with eggs at the rate of about 120 per plant. The following is based on the authors' summary. A graphic method of classifying strains as resistant, partly resistant or susceptible by plotting the mean number of larvae per plant against the mean date of silking for standard groups is presented, and the average rating on a numerical scale from 0 to 10 of 234 inbred lines tested as inbreds or in hybrid combination with common parents is given; 37 strains were tested as both, and the correlation between their rating as inbreds and in hybrids was highly significant.

In comparing artificially infested inbred lines of previously established resistance or susceptibility and their single-cross hybrids in adjacent hills, the relative numbers of larvae in the inbred parents and their hybrids were estimated to be, respectively, as follows: resistant  $\times$  resistant, 2.71 and 0.70; resistant  $\times$  partly resistant, 3.20 and 1.27; resistant  $\times$  susceptible, 3.69 and 1.83; partly resistant  $\times$  susceptible, 4.18 and 2.40; and susceptible  $\times$  susceptible, 4.67 and 2.96. The hybrids contained a nearly constant average of 1.86 fewer larvae per plant than the inbred lines from which they were derived, although their average date of silking was 7.1 days' earlier. Six widely-planted commercial double-cross hybrids were compared with some of the experimental susceptible and resistant single-cross hybrids in 1940-42, and were found to be about half as resistant as the resistant group of the experimental hybrids.

BIRCH (L. C.). **A Contribution to the Ecology of *Calandra oryzae* L. and *Rhizopertha dominica* Fab. (Coleoptera) in stored Wheat.**—*Trans. roy. Soc. S. Aust.* 69 pt. 1 pp. 140-149, 2 pls., 6 figs., 12 refs. Adelaide, 1945.

Practically all of the following is taken from the author's summary of this paper, in which results of experiments to determine the effect of temperature and moisture on the rate of multiplication of *Rhizopertha dominica*, F., and the small strain of *Calandra oryzae*, L., in stored wheat in Australia, most of which had been published previously [*R.A.E.*, A 34 21, 22, 122, 123, 188], are further discussed. Data on survival and rates of oviposition and development under various conditions of temperature and moisture are combined for each species to show the potential rate of multiplication over the complete range of temperature and moisture within which any increase can occur. All the stages of *R. dominica* were more resistant to dryness than those of *C. oryzae* and could develop at higher temperatures; the egg stage of both species was the most resistant to the harmful effects of dryness and high temperatures. The rate of oviposition of *R. dominica* was maintained at a high level in wheat at all moisture contents between 14 and 9 per cent. That of *C. oryzae*, on the other hand, fell greatly with any reduction of moisture content below 13 per cent. The maintenance of a high rate of oviposition by *R. dominica* in dry wheat enables it to multiply rapidly despite the high mortality of the immature stages under these conditions. Three-dimensional diagrams are given showing the rate of multiplication of each species in one generation at different combinations of temperature and moisture content. The maximum potential rate of increase under optimum conditions is about the same for the two species, but the optimum conditions for each occur in different parts of the temperature and moisture scales. In wheat with a moisture content of 14 per cent., *C. oryzae* multiplies more rapidly than *R. dominica* at all temperatures up to 31°C. [87.8°F.], but *R. dominica* multiplies the more rapidly at higher temperatures. In wheat with a moisture content of 11 per cent., however, *C. oryzae* can multiply more rapidly only at temperatures below 23°C. [73.4°F.].

BIRCH (L. C.). **The Influence of Temperature, Humidity and Density on the Oviposition of the small Strain of *Calandra oryzae* L. and *Rhizopertha dominica* Fab. (Coleoptera).**—*Aust. J. exp. Biol. med. Sci.* **23** pt. 3 pp. 197–203, 2 figs., 8 refs. Adelaide, 1945.

In determining the influence of temperature and moisture on rate of oviposition among insects, it is desirable that the density of the experimental insects should be kept constant and at an optimum, since the rate of oviposition is known to be dependent on it [*R.A.E.*, A **20** 661]. An experiment was therefore carried out in Australia with the small strain of *Calandra oryzae*, L. [cf. **34** 21] to determine whether a particular change in density produces a different quantitative effect on oviposition at different temperatures, and whether the optimum temperature for oviposition varies with density, since if there is an interaction between temperature and density, the results of experiments carried out at different temperatures, but the same density, must be interpreted with caution. The following is largely the author's summary of these investigations and of experiments with *Rhizopertha dominica*, F., the main object of which was to determine the lowest moisture content of wheat and the highest and lowest temperature at which sufficient eggs were laid to permit a rate of multiplication exceeding unity.

There was an interaction between temperature, density and time in their effects on the rate of oviposition of *C. oryzae*. The proportional effect of density was different at different temperatures and varied with the age of the insects. The effect of different temperatures also varied with the age of the insects. The maximum rate of oviposition was reached when the insects were one to two weeks old, depending on the temperature. The rate did not remain constant for any length of time except at 23°C. [73·4°F.]. The average length of life of the female was three months and of the male two months. At a density of one insect per 10 grains of wheat, the rates of oviposition at 25·5°C. [77·9°F.] and 29·1°C. [84·38°F.] were significantly greater than the rate at 23°C., but were not significantly different from each other over most of the insect's life. A higher maximum rate and total number of eggs were reached at 29·1°C. At a density of one in 50, a higher rate was reached over most of the insect's life at 25·5°C., and the total was greatest at this temperature. The main effect of reduced density of insects per grain was to increase the rate of oviposition after the first eight weeks. The effect of reduced density was greatest at 25·5°C., at which temperature the greatest number of eggs (384) was laid. The rate of oviposition and the total number of eggs laid were less at 32°C. [89·6°F.] than at 29·1°C. At 35°C. [95°F.], only five eggs were laid per female. No eggs were laid at 13°C. [55·4°F.], and at 15·2°C. [59·36°F.], one egg was laid per week. The lowest moisture content of wheat at which eggs were laid by *C. oryzae* was 10 per cent.; none was laid at 9·5 per cent. Fewer eggs were laid when the moisture content was 12 per cent. than when it was 14 per cent., and there was little difference in the numbers laid when it was 11 and 12 per cent.

Experiments with *R. dominica* showed that eggs were not laid at temperatures higher than 39°C. [102·2°F.]. The rate of oviposition at 18·3°C. [64·94°F.] was slow, only 38 eggs being laid in four months. The maximum number of eggs (415) was laid at 34°C. [93·2°F.] in grain with a moisture content of 14 per cent. The rate of oviposition did not fall off markedly in dry wheat until the moisture content was below 9 per cent. Wheat containing 8 per cent. moisture was the driest in which eggs were laid.

HILL (R. E.). **Effects of DDT and other Insecticides on several Species of Potato Insects.**—*Res. Bull. Neb. agric. Exp. Sta.* no. 138, 14 pp., 7 refs. Lincoln, Neb., 1945.

The relative value of DDT and the insecticides in general use in Nebraska for controlling insect pests of potato was investigated during 1944. *Epitrix tuberis*, Gentner, *Paratrioza cockerelli*, Šulc, and *Empoasca fabae*, Harr., were

the principal pests, but observations were also made on a number of less important ones and on beneficial insects. In a field experiment in western Nebraska, the dusts and sprays were applied on 15th and 23rd June and 3rd, 13th and 24th July at rates of 35 lb. and 125 U.S. gals., respectively, per acre. The dusts comprised 3 per cent. DDT in pyrophyllite, cryolite with sulphur (1 : 3 by weight) or basic copper arsenate with sulphur (1 : 4 by weight), and the sprays contained 4 lb. 10 per cent. DDT in pyrophyllite or 5 lb. zinc arsenite and 10 lb. wettable sulphur in 100 U.S. gals. water, and all brought about a marked reduction in populations of the three major pests and of *Chlamydatus associatus*, Uhl. DDT applied as either dust or spray was significantly more effective than the other insecticides against *Epitrix tuberis*, and it was the only one that was effective against adults and nymphs of *Aceratagallia uhleri*, Van D., which increased significantly following the applications of zinc arsenite and basic copper arsenate. The DDT dust was the most effective treatment in reducing the numbers of *Empoasca fabae* and adults of *C. associatus*, and the only one that markedly reduced populations of nymphs of *Macrosteles divinus*, Uhl., and both dust and spray caused a significant reduction of the nymphs of *Lygus elisus*, Van D., against which the other materials were of little value; none of the treatments had any significant effect on the adults of *Macrosteles* or *Lygus*. The zinc-arsenite spray caused a large increase in the numbers of *Myzus persicae*, Sulz., but none of the other materials produced any marked effect on it, although it was least numerous on plants dusted with DDT. Populations of predacious bugs (*Orius* and *Nabis*) and of Coccinellids were significantly reduced by dusts and sprays containing DDT, but Chrysopids appeared to be more resistant. It is suggested, however, that the destruction of beneficial insects by DDT is offset by the fact that, unlike other insecticides that also destroy them, it is effective against all the major pests. In another field experiment in western Nebraska, five applications at approximately weekly intervals between 30th July and 2nd September of a dust containing 3 per cent. DDT and of one containing 5 per cent. ortho-nitrodiphenyl were compared. DDT caused significant reductions in populations and feeding punctures of *Epitrix tuberis*, and nymphs of *P. cockerelli*, and significant increases in the yield of tubers of marketable size, the average weight of marketable tubers and the weight of good quality tubers per acre, but the ortho-nitrodiphenyl was of no value. DDT showed considerable residual effect against *P. cockerelli*, the numbers of nymphs increasing very little during a period of 27 days after the final application in September.

In a laboratory experiment with the four dusts used in the previous tests, adults of *E. tuberis* were caged with treated leaves for 112 hours, during the last 88 of which untreated leaves were also provided. The mortality percentages were 81 for DDT, 41 for cryolite, 22 for basic copper arsenate, 2 for ortho-nitrodiphenyl and 2 for no treatment. The differences between DDT and cryolite and between basic copper arsenate and no treatment were significant.

A dust containing only 1 per cent. DDT in pyrophyllite applied on 22nd June and 6th and 18th July gave excellent control of *Empoasca fabae* in a heavily infested field in eastern Nebraska. Although heavy rain fell shortly after the first application, the populations were still insignificant a fortnight later, and the foliage of treated plants was only slightly affected on 28th July, whereas 95 per cent. of that on the control plants was dead. The yield from treated and untreated plots averaged 70 and 18 bushels per acre, respectively. Practically all the nymphs found on the dusted plots were newly hatched and would presumably have been killed as soon as they moved about and came in contact with the dust. In western Nebraska, plants treated with DDT were larger and had better foliage than untreated plants or plants treated with other insecticides, but no significant decrease in the number of lesions due to early blight [*Alternaria solani*] was caused by it [cf. R.A.E., A 33 173, 207].